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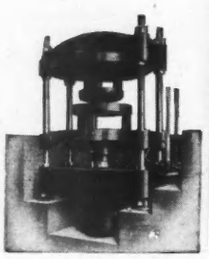

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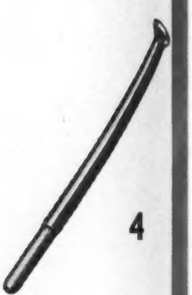

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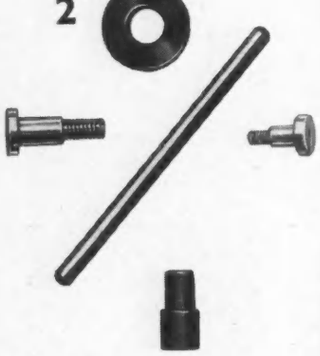

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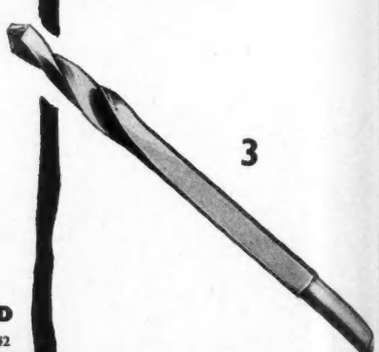

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ENGINEERING Impact

of Negotiations for Months and Contracts for Years

THE LONG TERM nature of the Anglo-Soviet trade prospects, mightily reinforced by the British Trade Fair in Moscow, turns out to be long term in more ways than one.

As is widely known, the many contacts made in the Soviet capital and the long lists of inquiries accumulated will take months of further marketing effort before contracts are signed. But quite apart from negotiations to come it has now become clear that the Soviet trading organizations favour contracts drawn in terms of years.

The Steel Company of Wales are to roll substantial quantities of steel from the USSR iron and steel industry, returning the material in its finished form. In Moscow, while the British Fair was in its early days, Fest, the Austrian iron and steel firm, reached agreement on contracts extending from 1962 to 1965. Under these contracts almost 3 million tons of coking coal, more than a million tons of iron ore and 60,000 tons of manganese ore will be bought from the USSR. Fest are to deliver almost 600,000 tons of rolled material, largely steel sheet.

The emphasis on contracts stretching well into the future is one of the most encouraging signs pointing to really significant increases in Anglo-Soviet trade. Even quite recently it has still been not unusual to meet the reservation that, since imports to the USSR are handled by government agencies, any trade whatever would be dangerously susceptible to changes in the political atmosphere.

Removing Doubts

This doubt is hardly likely to remain in the face of so much willingness to reach major capital agreements for years ahead. Big contracts with iron and steel, or chemical, interests are well within the pattern of using imports chiefly to build up Soviet industrial capacity. But they will also establish confidence, on both sides, and familiarity with trading organizations and techniques.

The United Kingdom, and Austria, are not in this alone. Competition to sell in the Soviet Union will more and more become as fierce as in other, far less advanced, markets. For beyond the current capital equipment contracts, themselves no mean prizes, lies an equally, or even more, attractive prospect.

A slight change in the United Kingdom Government's attitude to the Soviet desire to sell us much more than our present £1 million worth of oil products each year or a general increase in the level of British purchases from the USSR could be the beginning of a major change, of the importation of consumer goods as part of the normal pattern of trade.

Such a move would give the Soviet authorities a new economic flexibility with a value comparable to increased industrial capacity. If and when the consumer market of the USSR is opened, it will be the turn of the washing machine maker and the camera manufacturer, the toy firms and typewriter companies, to look very lively indeed—for the scramble will be international.

Iraq Wants Many More Factories

WHETHER it is a new factory for the extraction of liquorice juice or the production of polyethylene, it is part of the demand for greater industrialization in Iraq, which is now reported on by the industrialists and businessmen who formed the British Trade and Industries Mission to that country back in February.

Overseas markets can be classified in a number of ways, mostly by the sort of headache produced. One of them is whether they need prolonged credit or not; Iraq has a splendid inflow of revenue from the oil business. The USSR and the Eastern European states are helping with only a part of the investment proposed in the Iraq Government's expansion of industry plans. The British mission report that the Iraq authorities would like United Kingdom cooperation over a wide field.

The plants the Iraq Government would like to establish include those for the production of caustic soda, polyvinyl chloride, polyethylene, rayon spun fibre and staple fibre, rayon weaving and paper. This is only a start to the list. Yeast manufacture, motor vehicle assembly, tyres, batteries the assembly of radios, refrigerators and washing machines, the manufacture of firebricks, prestressed concrete sleepers and building components, all these are needed.

Aids to investment

Companies more interested in local participation than in selling capital engineering goods will find that there are special loans, tax concessions and exemptions from customs duty of raw materials and semi-manufactures. The Iraqis are aware of the need to mechanize their agriculture and there is scope here for the producers of tractors and agricultural machinery. The Iraq authorities have suggested that the United Kingdom manufacturers could assist by setting up two or three fully equipped service stations with hire and training facilities. There is an interest in the local assembly of tractors.

Have the Iraqis any complaints? There were some that British industrialists have shown insufficient interest in Iraq in recent years.

Several complaints were also made to the Mission that there had been shortcomings in after-sales service and the supply of spare parts. Certainly attention to these services is as essential in Iraq as in any developing territory.

Private industry and the Iraq Government would like very much more assistance from Britain in technical training, from the skilled workman upwards. The mission felt that something more was wanted than the existing arrangements for training Iraqis in UK techniques.

When the opportunity to train part of the industrial labour force of another country is put like this it would be an unfortunate lapse if some special effort were not made to fit some Iraqi students into our already insufficient technical training facilities, and to find some firms willing to give training. Perhaps there is also scope here for a few more Federation of British Industries scholarships?

of Electronic Telecontrol in Fuel and Power

AN interesting example of technical cooperation between three closely associated industries for the rationalisation of production of equipment needed by all three is provided by a recent step taken by the Joint Radio Committee of the nationalised fuel and power industries.

Over a number of years the coal, electricity and gas industries have worked closely together on radio communication and frequency planning problems through the joint committee.

In the remote indication and control of plant at unmanned points by either wire or radio links the three industries have many common needs. Starting from the basic similarities of their requirements, the joint committee has drawn up a basic specification for electronic telecontrol equipment. In addition to rationalisation of production, it is hoped that the basic specification will do away with the necessity to design equipments for specific applications on an individual basis.

Information on minimum facilities required, and technical guidance is given in the specification. Cold cathode tubes, transistors, magnetic cores and so on, are preferred to, for instance, electromagnetic relays and hot cathode valves. Care has been taken to avoid rigidly laying down the exact manner in which any facility is to be provided.

Two of them, Plessey and Pye Telecommunications, have successfully demonstrated equipments designed to fit the requirements of the basic specification.

Copies of the specification are available from the secretary of the Joint Radio Committee of the Nationalised Fuel and Power Industries, c/o Central Electricity Generating Board, Bankside House, Sumner Street, London SE1.

Longer Order Books and Even Longer Deliveries

FOR engineering and electrical manufacturers new orders received this March were 17 per cent above those of March last year. In the same period estimated production in the engineering and electrical goods industries had risen by 2 per cent.

Such is the success and the dilemma of the engineering industries. The maintained investment programmes of British manufacturing, in iron and steel, motor vehicles and a host of less multi-million pound schemes, and the recovery in the demand for powered consumer goods, have piled up new demands. Not only does engineering present a rather more lively picture than the economy overall, its export efforts have been above average. The export earnings of the industries in this year's first quarter were 15 per cent above those of 1960.

Orders from overseas have not been doing so well, the most recent figures of the Board of Trade show a 2 per cent increase in the first quarter, while home orders were up by 25 per cent.

What this is doing to delivery dates is obvious enough. What is wanted is a matching rise, and a swift one, in productivity. If it is not achieved the danger is real enough that foreign competitors will be in a position to exploit the long gap between order and delivery, and it is not much consolation that West German deliveries are reported to be under the same pressures.

Two sectors of the Board of Trade's recent figures are a little happier than for some time past. Without resolving the excess capacity of the heavy electrical engineering industry, the round of new orders from the Central Electricity Generating Board has underwritten the state of activity in a number of manufacturer's works.

At the same time domestic appliance demand has so far picked up that in March refrigerators were being delivered from the factories at 92 per cent of the rate in March, 1960, although two months before deliveries had been not much more than 60 per cent of the rate ruling a year earlier.

Ubiquitous Mathematics

A VERY gloomy picture of the state of mathematical education in Britain was given by Professor Bryan Thwaites when he delivered his inaugural lecture as professor of theoretical mathematics at the University of Southampton.

He gave warning that, in his opinion, mathematical education as it has been known in this country since the beginning of the century could come to an end within twenty years. There was, he said, not only a shortage of teachers but a serious decline in the qualifications of men applying for posts in schools and universities.

This view of the situation is in sad contrast to the happier state of affairs being reported only ten years ago. Then it was frequently being said that the mathematical ceiling of engineers was rising. Evening classes in specialist branches of mathematics at the London polytechnics were filled to capacity and were repeated in successive sessions to cater for those not accommodated first time.

Professor Thwaites' cure for the present ill is questionable. His first proposal to solve this "grave problem" is that the demands for mathematicians made by professions other than teaching must be voluntarily and severely contracted. There should also be widespread interchanges between industrial, commercial and government establishments on the one side and schools on the other.

The first part of the cure will surely defeat its purpose. Any further reduction in the number of mathematicians in the engineering industries and there will be no industrial employers left to employ the mathematicians that may meanwhile be produced. The second suggestion of interchange of staffs was for a long time believed to be the best solution of the difficulties met in turning out a sufficiency of engineers. It never did succeed except in very small doses and the sandwich system—interchange of students—has proved a better proposition.

Professor Thwaites is right, however, to warn of the consequences of a falling standard in mathematical training. And industry will do well to take heed for it cannot afford to have fewer mathematicians: both better designs and better management can be based on sound mathematics.

Turbochargers for Large 2-Stroke Diesels

Advanced design, which includes the use of plain bearings, easy access to rotating parts and large capacity air filters, ensures a long trouble free life for this range of turbochargers.

THE advantages obtained by applying turbochargers to diesel engines are well known, but simply stated they are greater power and increased efficiency for a given frame size of engine. Applications for turbochargers are as widespread as that of the diesel engine itself.

Up to about 50 per cent increase in power on a normally aspirated engine may be obtained with minimum pressure turbocharging to 7 lb per sq. in, without greatly modifying the engine because the thermal and stress loadings of the engine remain almost unaltered. In addition, the derating conditional to a normally aspirated diesel engine at high altitudes and in warm climates can be reduced by turbocharging.

The range of turbochargers produced by Hawker Siddeley Brush Turbines vary in size from the Series 10 with an air mass flow of 2 lb per sec, to the Series 40 and 50 with an air mass flow of 36 lb per sec. The 40 and 50 Series—a sectional drawing is shown in Fig. 1—are discussed here, as they form the latest addition to HSBT's range. They were designed specifically to meet the demands of the large two-stroke marine diesels. In this field, turbocharging has brought with it the reduced weight and space requirements which are of such cardinal importance to ship owners. It is interesting that Doxford's are fitting the 50 series to their range of P-type engines.

It was on this six-cylinder engine that HSBT were able to gain operating experience with the 50 series, and a 1200 hour shop running trial on the Doxford engine showed that the turbocharger gave the necessary performance and reliability requirements.

"Turbine adaptability" is a phrase one hears at HSBT, and this is borne out by the fact that the 40 and 50 series have been designed to combine the experience gained with the smaller units, and the embodiment of their proven design features. Air is drawn in through the large capacity filter (the octagonal shape on the right of Fig. 2) which can be detached and cleaned while the turbocharger is in operation. Because of the generous capacity of the filter, fouling of the impeller and the diffuser are delayed.

From the filter, the intake air passes through annular silencing rings. Most of the noise emitting from a turbocharger is due to the characteristic whine of the centrifugal impeller, and when testing it on the Doxford engine it was found that by increasing the number of annular rings from seven to eleven, the noise level at the troublesome frequency was reduced by 78 per cent.

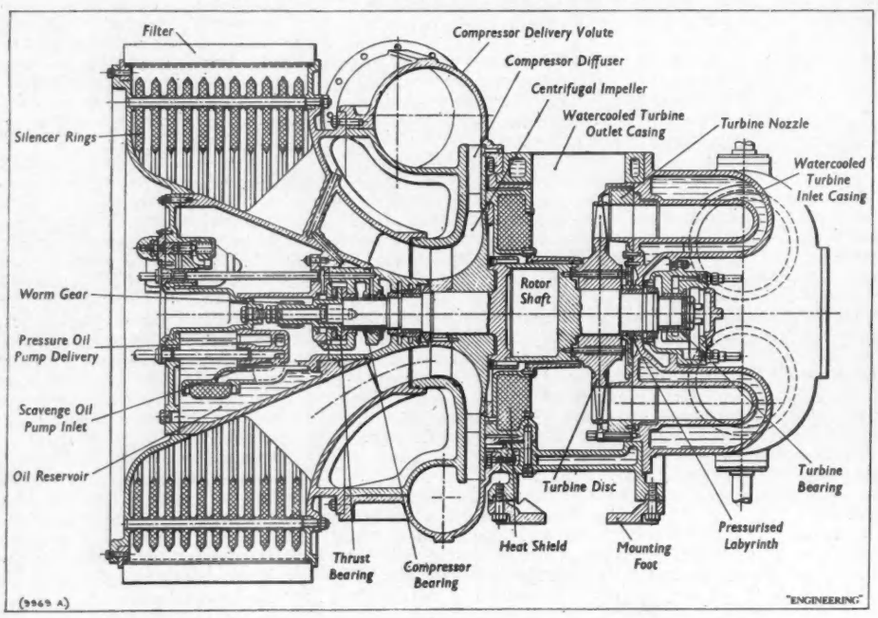
After leaving the silencer the air flows through the compressor impeller (Fig. 3) which is made of light alloy, with separate steel inducers. These inducer vanes—which are individually precision forged in FV520 steel—are attached to the hub by broached fir tree roots. Two sizes of impeller are available. The air is then delivered under pressure to the engine scavenge pump or intercooler and then to the induction manifold.

Exhaust gases from the engine cylinders pass to the single-stage axial flow turbine through water cooled casings. Alternative casing positions allow a neat layout of piping on any installation. Should any foreign bodies enter the turbine, a strong nozzle construction and tapered turbine blades with a substantial root dimension help to reduce any damage that might be caused.

Easy maintenance is assured because the rotating parts can be withdrawn from either end of the turbocharger, and if necessary the turbine disc can be replaced without the need for rebalancing the rotor or renewing any other part of the rotating assembly.

Plain bearings of special lead-bronze carry the rotor shaft, which consists of two steel forgings. Because of the light and steady load put upon the bearings they have, according to HSBT, a life equal to that of the turbocharger. Should they become damaged, however, the bearings and the journal sleeves can be easily replaced without the need for re-balancing. Axial movement of the rotor shaft is limited by a tilting pad thrust-bearing on the pressure side and a plain segmented bronze ring on the other. Turbocharger rotor speed response with plain bearings is said to be similar to that achieved with anti-friction bearings.

Fig. 1 Cross-section through the 50 series turbocharger.



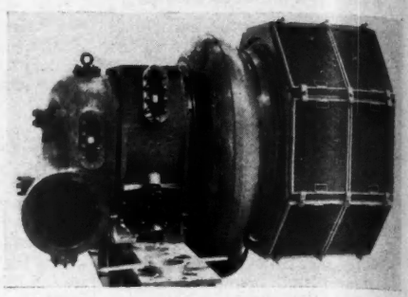


Fig. 2 The assembled turbocharger showing the single entry turbine, outlet and volute casing and the large capacity air filter.

Lubrication can be self-contained, in which case an integral gear pump, worm driven from the rotor shaft is fitted, or it can be self-contained with an emergency auxiliary supply. Alternatively it can be operated directly from the main engine system with additional filters mounted in the turbocharger. The unit will operate continuously and satisfactorily when inclined in any direction at up to 40° from the horizontal. The oil filters are visible in Fig. 4.

The design permits various blade heights, nozzle and diffuser areas and impeller sizes to be used to facilitate matching the characteristics of the turbocharger with any engine within the operating range of the frame size.

Turbine bearing and intake bearing assembly are always mounted in the vertical position to allow for correct oil drainage, but the casings can be arranged in any of twelve angular positions.

Hawker Siddeley Brush Turbines Limited, Hucclecote, Gloucester.

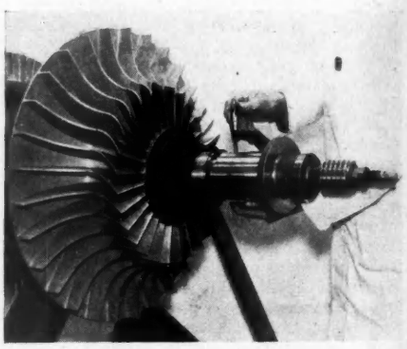


Fig. 3 The precision forged impeller inducer vanes have fir-tree root attachments.

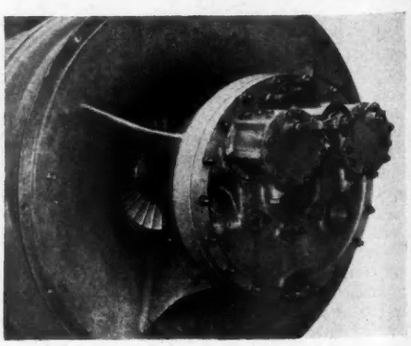
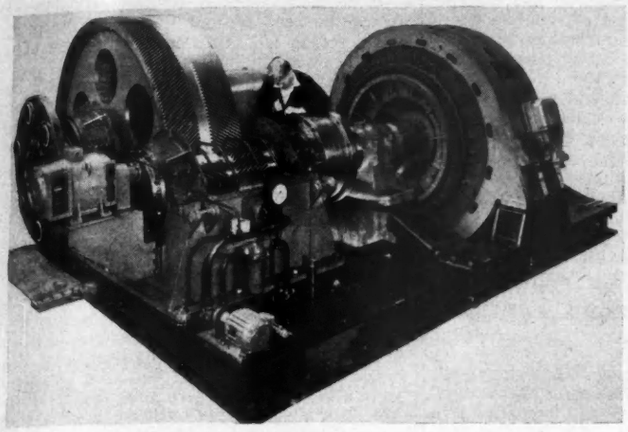
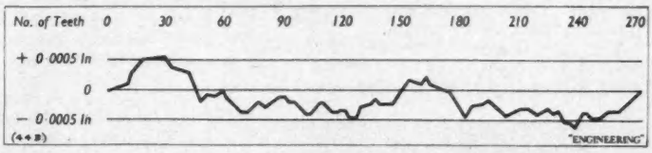


Fig. 4 View from compressor end, showing oil filters, oil level gauge and oil filler plug.

Allowing for Deflections in Mine Winding Gear





(Left) Three types of gearbox have been designed by AEI for mine winding gear to be mounted on towers. This one is a single-reduction type.

(Above) Cumulative pitch error record of an 8 ft 6 in gearwheel showing that the maximum variation barely exceeds ± 0·0005 in.

Tower mounted friction winders, which are now firmly established in the mining industry, can be installed on concrete or steel structures. Because the latter are not inherently rigid, gearboxes must be designed to allow for any deflections which may occur during normal winding operations.

Three types of gearbox have been designed by the Heavy Plant Division of AEI for this application. They are:—

(1) A double-reduction, divided-drive, coaxial unit.

(2) A single-reduction unit.

(3) A twin-pinion single-reduction unit for twin-motor drives.

With the coaxial arrangement the input torque is equally divided between the two first-reduction gearwheels, and then transmitted through quill shafts and flexible couplings to two second-reduction pinions meshing with a final gearwheel on the slow speed shaft. Such an arrangement allows the necessary torsional flexibility between the primary and secondary gears, and gives a gearbox of minimum weight and size. By housing the motor drive-end bearing in the gearbox—the first reduction pinion being overhung on the motor shaft—the overall length of the winder is still further reduced.

Single-reduction gearboxes with either single or twin-motor drives have the double-helical pinions connected to the motors through flexible couplings.

All three arrangements have a slow-speed torque shaft fitted between the final gearwheel and the winder. This is housed inside the hollow shaft of the gearwheel and is provided with a flexible coupling at each end. The torque shaft and its coupling can function with a misalignment in any direction of not more than $\frac{1}{4}$ in between the winder shaft and the slow-speed shaft of the gearbox. Torsional flexibility, necessary to ensure damping of the peak loads during winding and heavy braking, is provided.

Self-aligning double-roller bearings suitable for heavy duty are used, these being of a capacity sufficient to ensure a long trouble-free life. All gears are spray lubricated, and each gearbox has a complete and independent oil system.

Cut on hobbing machines housed in temperature controlled cells, the gear teeth are machined to BS grade "A" accuracy, thereby ensuring complete absence of noise and vibration. The graph shows the cumulative pitch error record of an 8 ft 6 in diameter winder gearwheel. It can be seen that the maximum variation throughout barely exceeds 0·0005 in.

AEI Limited, Crown House, Aldwych, London WC2.

Developing the Rolls-Royce Spey Jet Engine

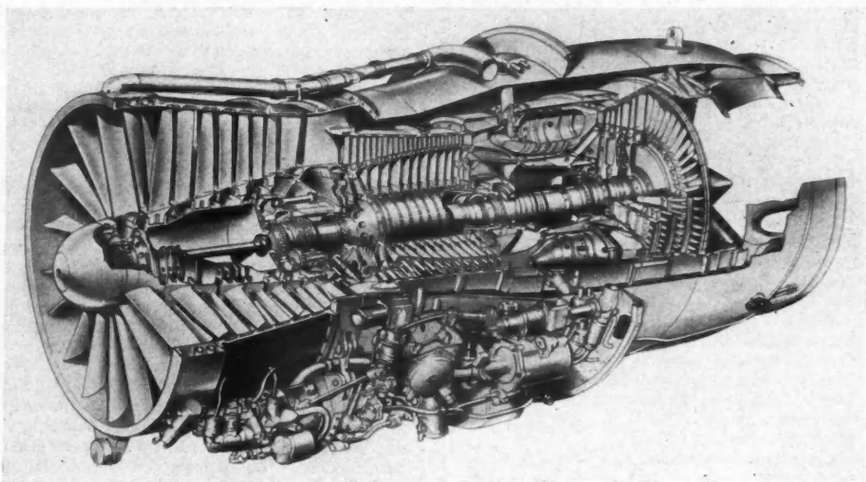
When the BAC One-Eleven short haul jet airliner was announced recently it was stated that the power units would be Rolls-Royce Spey by-pass jets. In addition, the de Havilland Trident will have the same power units. Earlier this year the Ministry of Supply placed a contract with Rolls-Royce to develop a military version of the Spey.

The company have recently released a progress report on the development of the engine which was designed as a low-economy engine in the 10,000 lb thrust class suited for the short-haul jet transports.

Design work began in 1959 and the first engine ran at the very end of last year. Five are now running and over 250 hours have been clocked so far with approximately half of this on one engine which has completed a 60 hour endurance test. The experience gained on this engine is backed up by the more extensive development testing accumulated on the earlier RB141 from which the Spey was developed, and has enabled improvements to be incorporated in the Spey in advance of its own development.

A typical example of the way the RB141 has facilitated the progress with the Spey has been the series of tests on the engine simulating the compressor entry flow conditions found with the centre air intake on the three engined Trident. From this it has been possible to go direct to test-bed running of the Spey fitted with the complete centre intake duct and entry cowl of the Trident.

The fuel control system for the Spey has been designed on new principles and aims at producing a less dirt-conscious, less leak-prone system of the speed-selection type. Among other new design features is the LP compressor which carries four stages of rotor blading. It is of simple drum construction and strain gauging tests have been performed to determine blade operating stresses. This form of compressor construction is used in the later Conway



Chosen as the power unit for the dH Trident and the BAC One-Eleven, the Rolls-Royce Spey is now undergoing development tests.

engines, the engine from which the Spey and the RB141 have been evolved. The by-pass air/engine exhaust mixer has individual chutes which direct the by-pass air into the turbine exhaust, thus ensuring a high degree of mixing of the two streams to achieve a lower mean exhaust velocity, which in turn benefits the engine's fuel consumption.

Soon the Spey will be under test in Rolls-Royce's altitude test facility where it will be subjected to the full range of conditions of the Trident's flight envelope. Static testing will take place at the company's Flight Test Establishment at Hucknall, Nottinghamshire, on a Spey power plant complete with a Trident production-standard pod, thrust reverser and noise suppressor nozzle. In August two Speys will commence test flying in an Avro Vulcan and following initial running ground trials in the Trident the engines will be ready for prototype flight trials of the aircraft.

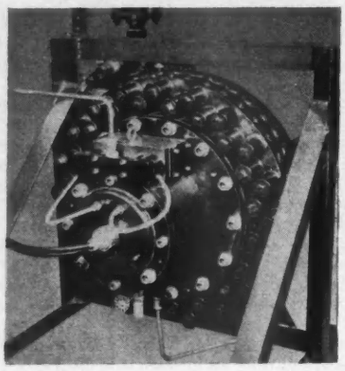
Take-off thrust for the Spey is given as 9,850 lb static thrust at minimum sea level and a typical cruising consumption is given as 0·766 lb per hr per lb at 25,000 ft ISA and Mach 0·78.

Rolls-Royce Limited, Aero Engine Division, PO Box 31, Derby.

Valve Gives 2 Million Cycles Unattended

A 40-way selector valve has been developed for the burst slug detection system at the Trawsfynydd nuclear power station.

The valve is required to work unattended for periods of two years and these special operating conditions call for outstanding reliability and



This 40-way burst-slug detection valve has to perform over 2 million cycles without attention.

peak efficiency. This can be gathered when it is realised that the valve has a cycling time of 30 sec, which in two years will amount to over two million cycles.

The entire driving mechanism is grouped in a serviceable sub-assembly which incorporates a self-sealing device for rapid removal, under load without additional shut-off. This sub-assembly can be easily removed and replaced in under 20 min.

Plessey Nucleonics, the makers, have built into the valve a unique ratchet indexing mechanism which ensures positive and accurate location at each index. The valve's built-in pneumatic operation makes an external driving shaft unnecessary thus eliminating the need for rotating shaft seals, and the static seals employed ensure that there is no leakage to atmosphere.

Plessey Nucleonics Limited, Weedon Road, Northampton.

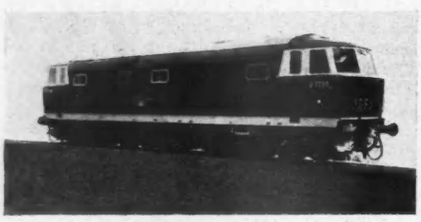
Diesel-Hydraulic Locomotives

The first of 95 diesel-hydraulic locomotives was recently handed over to the Western Region of British Railways. Deliveries of the remainder will be completed during 1963.

Known as Type 3, the locomotives are powered by one Bristol Siddeley Maybach MD 870 engine coupled to one K 184U Stone-Maybach Mekydro hydraulic transmission box. The rated bhp is 1,700 and the locomotives are designed for general purpose work on main lines with a maximum speed of 90 mph.

Considerable attention has been given to the accessibility of parts with a view to easy maintenance. Clean and simple lines have been attained by keeping the locomotive as free as possible of extraneous detail.

The control equipment, supplied by Brush, is arranged for multiple unit operation and



The first of 95 diesel-hydraulic Type 3 locomotives.

comprises pneumatic control for diesel engine speed and electrical control for all other equipment. Both the locomotive and the diesel engine have protection against overspeed. Other protective devices integrated in the control system cover the lubricating oil, cooling water and transmission oil temperatures and the water level in the radiator header tanks.

Cabs are insulated against noise by Fibreglass insulation on the bulkheads and roofs, and the cab canopies are Fibreglass mouldings.

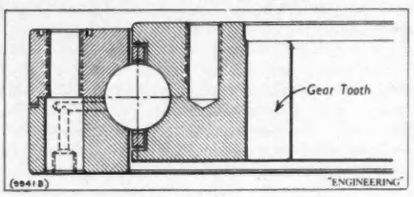
The locomotives are being built by Beyer Peacock (Hymek) Limited in which Bristol Siddeley Engines and J. Stone and Company (Deptford) are partners with Beyer Peacock and Company Limited.

Beyer Peacock (Hymek) Limited, Locomotive House, Buckingham Gate, London SW1.

Simpler Bearing Layout for Pelletizers

Pan pelletizers are used for granulating materials in the chemical and fertiliser industries. Designs for such pelletizers are greatly simplified if a single bearing is used.

Roballo have supplied several bearings for use in fertiliser pelletizers. Such a one is illustrated. A Roballo single-row ball bearing of



90 in diameter ball bearing with gear drive cut directly into the inner ring.

7 ft 6 in diameter supports the pan. The ball races of the bearing are flame hardened to a minimum of 500 Brinell. The drive gear is cut directly into the inner ring. No housing is needed for the bearing, which is fixed by 24 screws of $\frac{7}{8}$ in diameter in each ring to machined surfaces on the underside of the pan and on the base.

Roballo Engineering Company Limited, 43 Dover Street, London, W1.

Dry Bearing Surface Treatments

Wide use is being made these days of bearings which can run dry or unlubricated. A process developed by Glacier has been applied to over 4,000 components ranging from gears and thrust washers to slideways and spindles. It permits parts of components to be used as the bearing surface to be treated with materials which give a low-friction, wear resistant surface.

The materials used are coded DG and DL, the former being based on ptfe and the latter on molybdenum disulphide. The treatments can be applied to components which for various reasons cannot be re-designed or modified to make use of standard dry bearings.

An example is the treatment of rotary cutting knives used in producing confectionery. Frequent stoppages occurred on machines used for cutting toffee because pieces of toffee clung to the sides of the knives and prevented the toffee being cleanly cut. Surface treatment of the side faces of the knives has reduced this tendency and stoppages to the machines at the factory have been cut by 75 per cent. This is important because a whole sequence of operations is linked and a stoppage of one machine means a complete breakdown of the process.

Glacier DG and DL treated components are in use in a large variety of applications the most recent of which include casting machines, measuring instruments and cranes.

The Glacier Metal Company Limited, Alperton, Wembley, Middlesex.

Automatic Starting of Standby Generators

Provision of an emergency power supply to take over electricity supplies to such vital items as pumps, blowers or controls should the main power source fail is an essential feature of a nuclear power station.

Emergency power is usually provided by generators driven by internal combustion engines. These are automatically started by compressed air released from storage vessels on failure of the normal electricity supply. When the engine has started, the air supply is shut off. Up to the present the UKAEA say that engine starting arrangements have tended to become complex which has led to an element of uncertainty in regard to the completion of the operational sequence.

The design offices of the Risley Headquarters of the UKAEA have put forward a simplified starting arrangement, the licence for which has been passed to an engineering company. It is in use at the experimental station at Dounreay and on the emergency generating engines of the AGCR at Windscale. CEGB are also including it in some of the nuclear power stations now being constructed.

Basically the device consists of a single valve controlling the admission of compressed air to the engine. Normally closed, the valve is opened by a falling weight which until the electricity fails is held suspended by an energized solenoid. When the engine has started, the pressure of the oil in the main lubricating system closes the valve and at the same time latches the operating weight in the original position ready for the next start.

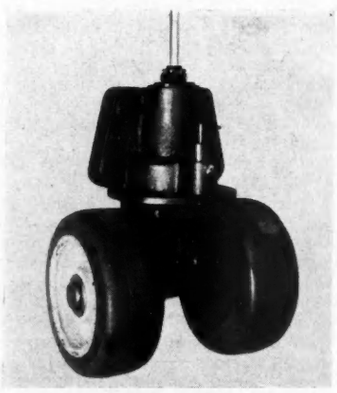
United Kingdom Atomic Energy Authority, 11 Charles II Street, London, SW1.

Pyropress Engineering Company Limited, Bedford.

Swivelling Wheel Unit with Brakes

A new design of swivelling wheel unit is available with internal expanding brakes. Each of the two 10 in diameter rubber tyred wheels is fitted with a $6\frac{1}{4}$ in diameter brake both of which are adjustable.

The brakes are applied by a cantilever arm



Two units can be coupled for Ackermann steering.

which incorporates a strong compression spring. They are released by pulling a vertical operating rod which passes through the swivel spindle and locates in a universal ball unit in the cantilever arm. A spring loaded plunger can lock the unit in any of four positions.

Taper roller bearings are fitted in the head and the wheels themselves have needle roller bearings running on a hardened ground shaft. Normal dynamic load is 2 tons. The unit is being made with towing lugs and two units can be coupled for Ackermann steering.

Autoset (Production) Limited, 73-74 Stour Street, Birmingham 18.

Plain Words

By Capricorn

HOWEVER just our cause, we seldom make our protests heard unless we shout together. We may be members of some mighty host invested with a noble common interest, but if we are not organized and have no public voice, we might as well go home. It is with such a hopeless feeling that I view my prospects as a militant consumer. But look out! I am about to rear my ugly head.

We are legion but disorganized, powerful but undirected. Yet already we have our manifestos, our revolutionary literature. *Which* and *Shoppers' Guide* are a beginning. Long have we been patronized, persuaded and cajoled, but we are ready now to man the barricades.

We seldom have the opportunity to see a worm turn, but we all enjoy the spectacle. In those slightly old-fashioned drawing room comedies there was nearly always a point somewhere halfway through Act 3 when the henpecked husband suddenly asserted his authority and from then on had no further trouble with his erstwhile domineering mate. I always liked that bit.

The biggest worm today is the consumer—as distinct from the producer. It is you and I buying a pound of meat or a new car as opposed to you and I organizing the meat market or manufacturing cars. It is Dr. Jekyll and Mr. Hyde on the grand scale. The " we " as producers are highly organized and well able to take care of our economic interests. The " we " who are consumers are very much the lowest common denominator of us all.

Recently, the Consumers Council in the coal industry complained because it had not been advised before the last round of coal price increases were announced. The Ministry concerned, mildly surprised at this interruption from the wings, said it was sorry but there were special circumstances. There always are when the consumer lifts his voice.

Here, however, was a voice crying in the wilderness in our common interest, so let us note its message with due gratitude. Since the war little has been heard from or about the various consumer councils which were established at that time. The council for the railways has been heard occasionally but its cries have been drowned in the thunder of the unions and blasts from the Ministry of Transport.

True, we have the Monopolies Commission, the Restrictive Practices Act and the Court which has been created under it. But I am never quite certain whose interests they are designed to serve—those of the consumer, the nation, the smaller manufacturer or possibly some abstract economic beast.

But the banners are unfurled; user and consumer are on the march, customers and passengers, queuers and commuters. I only hope we do not break and run when we see our other selves, as producers and trade unionists, salesmen and shopkeepers, arrayed in serried ranks against us.

Letters to the Editor

Can Design be Taught at Universities?

SIR, It is not my custom to rush into print when provoked by correspondence in the press, but I cannot resist discussion of the letter sent to you by Mr. Hugh Clausen (ENGNG., 17 Mar. '61, p. 376).

On the basic issue, I think most people will agree that the achievement of competence in design of any sort needs a far longer and more concentrated apprenticeship than the time which can be devoted to the elements of the subject during a normal university course. Nevertheless, the basic requirements of good mechanical or structural design can certainly be indicated in such a course, provided that the lecturers themselves have had the requisite experience and have kept in touch with developments.

It is evidently impossible for any man, during one short life span, to have all the academic and practical experience necessary to make him the perfect university lecturer. On the other hand, I feel strongly that Mr. Clausen and others would have less ground for complaint if all university lecturers in engineering were required to have had not less than, say, five years of first-class design and construction experience in industry after graduation, and before returning to the universities as lecturers.

I was privileged to spend the period 1924-7 taking an honours degree and diploma course in civil and municipal engineering at University College, London. During that course there were very adequate, supervised, drawing office sessions in which there was every opportunity to develop existing latent skills in draughtsmanship and the rudiments of design, or to implant some where none existed before. It was, of course, evident that a liking for drawing, as such, was a considerable advantage.

It should be also recorded that, at that time, the students received regular lectures from practising engineers in railways, docks and other branches of their work and that the professors and lecturers were all well qualified in practice. Incidentally, at that time, University College London ran lectures in hygiene, which, as far as I know, were the first of their kind in public health engineering. I attended them as part of the municipal engineering course during which we designed such things as full-scale water supply and sewerage-distribution and purification schemes.

Many years of experience and contact with engineers of all sorts, both in this country and abroad, has convinced me that a period of several years, concentrating on design at a drawing board, is a discipline to which every aspiring engineer should be subjected. It is only by having to express one's ideas clearly and concisely on paper, following the necessary technical research and calculations, that one learns to be able to back up one's opinions with something better than the " inspired " guesses of the man who has nothing but practical experience to guide him. Designing is far from being the menial occupation which Mr. Clausen seems to believe is a generally-held view, but, undoubtedly, the rewards are inadequate.

Obviously, both design and practical experience are essential to the " complete " engineer, and the latter is indispensable to the proper execution of design. But lack of the requisite training in design during the early stages of one's career is, I am convinced, something which can never be made good at a later stage.

In conclusion, I wish to correct one erroneous impression given by Mr. Clausen. Surely he is wrong in saying that the professional institutions ignore design. The Institution of Civil Engineers, for example, require candidates for election to associate membership to submit adequate evidence of design experience.

Yours faithfully,

A. H. TOMS.

Hove, Sussex.
24 May, 1961.

Closed Circuit Television

SIR, At Worksop your article " Closed-Circuit TV Grows with Its Uses " (ENGNG., 12 May '61, p. 650) was received with some misgiving, due to the absence of a mention of the new service introduced by this company last month.

While not in any way intended to compete with the systems designed for specific applications by the major television companies in this country, the service we offer is unique in that it is a service immediately available and based on a number of years experience throughout Europe, and thus offers an alternative for applications which do not merit the purchase of a special set of equipment or the training of operators.

Our sewer-inspection service offers standard equipment for the inspection of pipes or sewers of 8 in diameter or larger, which can be inspected at the rate of up to 400 yards per day and can deal with distances of up to 350 yards between access points.

A miniature camera is available for smaller diameter pipelines, while, in the field of underwater television, we can offer equipment for the inspection of objects as deep as 80 fathoms (160 yards). The equipment also has a unique attachment to permit viewing in turbid waters, allowing visibility in conditions where a diver must work blind.

Other equipment is available for the inspection of wells and boreholes, while, for the engineer who wants a record, a ciné or still photograph of the complete screen can be taken.

This new service is proving a great asset to those engineers who do not feel that they themselves want to venture into what is necessarily a highly specialized field.

Yours faithfully,

M. WEBB.

General Descaling Company Limited,
Worksop, Nottinghamshire.
2 June, 1961.

Selwood Orbital Engine

SIR, I have read with interest your article on the Selwood orbital engine (ENGNG., 19 May '61, p. 682) but surely the statement:

" Because the pistons are not reciprocating there are no inertia forces acting on them, and with no connecting rod there are no side thrusts on the cylinder walls " cannot be correct?

Whether or not the motion of the pistons be regarded as reciprocating, they are nevertheless translated back and forth as the cylinder block revolves and, hence, accelerations in a direction parallel to the axis of the engine are set up. Inertia forces in this direction must, therefore, also exist.

Furthermore, torque can be transmitted only by the reaction between piston and cylinder, and due to centrifugal action, a radical force will be set up, shared between the spider and the cylinder walls in proportions determined by the detail design of the various parts of the piston and spider.

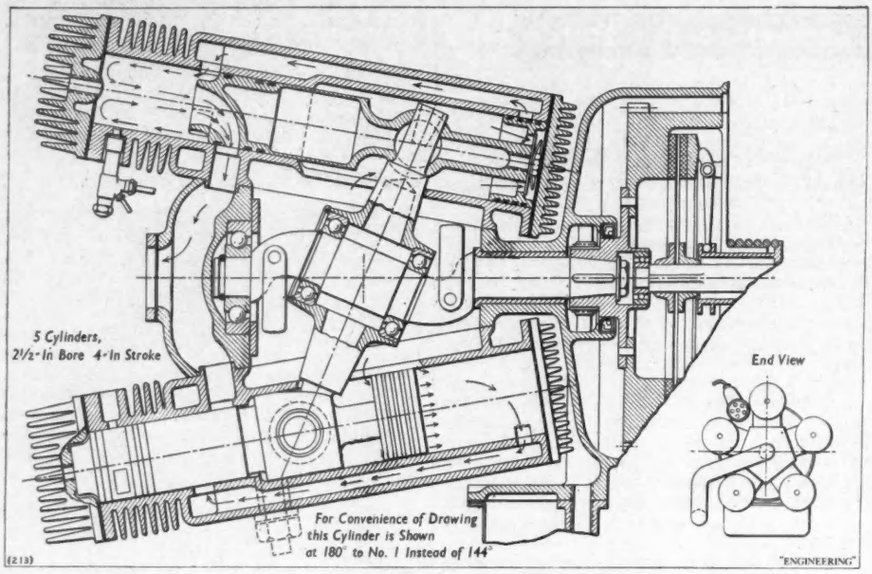
This last force may be quite large: at a maximum speed of 12,000 rpm, and assuming the centre of gravity of the piston to act at a distance of $3\frac{1}{2}$ in from the axis, centripetal accelerations of the order of 14,000g are possible.

Yours faithfully,

R. W. READER.

Tunbridge Wells.
31 May, 1961.

SIR, Having seen the Selwood engine illustrated on television, I was pleased to see further details in your journal (ENGNG., 19 May '61, p. 682.)



The Zed crank engine.

These pictures reminded me that some 22 years ago I prepared the drawing of a Zed crank engine reproduced here, which had similar torque characteristics.

It probably could be constructed much more cheaply as no intricate machining is required. In place of a carburettor, the petrol and oil mixture is injected into the cylinder on the commencement of the compression stroke. Ignition is by coil and plug.

Clean filtered air enters the pump cylinder via a disc valve in the pump piston, and on the return stroke, air under pressure scavenges the power cylinder so that there is no inert gas to retard the explosion of petrol and air. The five equally-spaced arms on the waffle plate fit through the bushes in the piston crosshead, providing a universal-joint effect at this point, ensuring ample tolerances to allow for machining errors and distortion.

In this instance, the air-cooled cylinders are stationary so as to ensure more equable cooling. In a Zed crank engine with a stationary crank, it might be necessary to use water or oil for engine cooling.

Yours faithfully,
ERNEST OWEN DAVIES.

Herne Bay, Kent.
22 May, 1961.

Teaching Traffic Engineering

SIR, In your Human Element note on the open day held at the University of Birmingham ("Traffic Engineers at Full Speed Ahead," ENGNG., 19 May '61, p. 689) you report on a welcome addition that has been made to the university teaching of highway and traffic engineering. The exaggerated statements made at that meeting show how short is the memory of even the university public.

Just after the war, R. B. Houndsfield led the universities of this country in teaching and in research in traffic engineering at University College London under Professor H. J. Collins. In any history of this subject in Britain the part played by Houndsfield should not be forgotten.

His was the "pioneer" work in traffic engineering in British universities. His untimely death at the age of 39 cut short a career whose continuance would have resulted in the production of many more highway engineers trained in traffic engineering techniques.

Yours faithfully,
W. FISHER CASSIE.

Department of Civil Engineering,
University of Durham King's College,
Newcastle upon Tyne 2.
2 June, 1961.

Events in Advance

New Developments in Reinforced Plastics

ANOTHER International Reinforced Plastics Conference, the third of the series, has now been arranged and will be held in London from 28 to 30 November, 1962. Like its predecessors, which were held, respectively, in Brighton in 1958 and in London in 1960, next year's conference is being organized by the British Plastics Federation.

Some 600 delegates attended the 1960 event in London, thereby rendering it the largest conference of its kind to be held in Europe up to that date and very considerable support has already been forthcoming for the new meeting.

The Federation's organizing committee is now inviting the submission of papers for the 1962 conference and will welcome suggestions for consideration. Prospective authors are asked to submit the proposed titles of their papers, together with short synopses, as soon as possible. These should be sent to the secretary, British Plastics Federation, 47–48 Piccadilly, London W1 (telephone: REGent 2041). An outline of the programme and details of the London venue of the conference are expected to be available shortly.

Exhibitions and Conferences

Arranged in chronological order

Pure and Applied Chemistry, 18th International Congress.—Sun., 6 Aug., to Sat., 12 Aug., in Montreal. Apply to the secretary, Central Committee, 18th International Congress of Pure and Applied Chemistry, National Research Council, Ottawa, Canada. (*To be preceded by 21st International Conference 2-5 Aug.*)

Messina International Samples Fair.—Sun., 6 Aug., to Mon., 21 Aug., at Messina. Apply to the Ente Autónome Fiera di Messina, Messina, Italy.

Dublin Horse Show.—Tues., 8 Aug., to Sat., 12 Aug., at Dublin. Organized by the Royal Dublin Society, Ball's Bridge, Dublin.

Cambridge University Physical Chemistry Summer School.—Sat., 12 Aug., to Sat., 19 Aug., at Cambridge University. General topic: "Fast Reactions." Apply to Professor R. G. W. Norrish, Department of Physical Chemistry, The University, Cambridge.

"Model Engineer" Exhibition.—Wed., 16 Aug., to Sat., 26 Aug., at Central Hall, Westminster, London SW1. Organized by *The Model Engineer* (Percival Marshall and Co., Ltd.), 19-20 Noel Street, London W1. Tel. GERrard 8811.

Energy, Conference on New Sources of.—Thurs., 17 Aug., to Sun., 27 Aug., in Europe. Sponsored by the United Nations. Apply to the Office of Public Information, United Nations, New York, USA.

Canadian National Exhibition.—Fri., 18 Aug., to Mon., 4 Sept., in the Exhibition Grounds, Toronto. In the United Kingdom, apply to the Canadian National Exhibition Representative, British Columbia House, 3 Lower Regent Street, London SW1. Tel. WHItehall 2794.

Ergonomics, First International Congress on.—Sun., 20 Aug., to Wed., 23 Aug., in Stockholm. Theme: "The Adjustment of Work and Working Environment to Man." Organized by the International Ergonomics Association. Inquiries should be addressed to Professor Sven Forssman, Svenska Arbetsgivareföreningen, Post Box 16120, Stockholm 16, Sweden. United Kingdom representative on the Association's provisional committee: Mr. Ronald G. Stansfield, 213 Fairview Road, Stevenage, Herts.

Wellington International Trade Fair.—Tues., 22 Aug., to Sat., 9 Sept., in Wellington. Organized by the Wellington Show Association, Wellington, New Zealand.

Gas Dynamics Symposium, Fourth Biennial.—Wed., 23 Aug., to Fri., 25 Aug., at the Northwestern University, Evanston, Illinois, USA. Organized jointly by the University and the American Rocket Society. Apply to the Gas Dynamics Symposium, Mechanical Engineering Department, Northwestern University, Evanston, Illinois, USA.

Radioisotopes in the Biological Sciences, Conference.—Wed., 23 Aug., to Fri., 1 Sept., but may be changed to dates in December. Apply to the International Atomic Energy Agency, Kaerntnerring, Vienna 1, Austria.

Radio and Television Exhibition, 28th National.—Wed., 23 Aug., to Sat., 2 Sept., at Earls Court, London SW5. Organized by Radio Industry Exhibitions Ltd., 59 Russell Square, London WC1. Tel. MUSeum 6901.

Technics and Technical Achievements, Fifth International Fair of.—Wed., 23 Aug., to Sat., 2 Sept., in Belgrade. Apply to Beogradski Sajam, 14 Bulevar Vojode Misica, Belgrade.

Textiles: Men's Fashion Week.—Sat., 26 Aug., to Mon., 28 Aug., in Cologne. United Kingdom inquiries should be sent to Mr. Neven du Mont, 123 Pall Mall, London SW1. Tel. WHItehall 8211.

International Civil Aviation Organization (ICAO): Diplomatic Conference on the Unification of Certain Rules Relating to International Carriage by Air Performed by a Person Other than the Contracting Carrier.—Tues., 29 Aug., in Montreal (tentative). Offices of ICAO: Montreal, Canada.

British Association Meeting.—Wed., 30 Aug., to Wed., 6 Sept., at Norwich. Apply to the secretary, British Association for the Advancement of Science, 18 Adam Street, Adelphi, London WC2. Tel. TRAfalgar 5733.

Meetings and Papers

The address and telephone number of the headquarters of each institution are given at the end of this list. Meetings in the headquarters town are held there unless otherwise stated.

Association of Supervising Electrical Engineers

CHESTER
"Circuitry and Applications of Transistors": Discussion. Chester Branch. Westminster Hotel, City Road, Chester. Tues., 13 June, 7.45 p.m.

Institute of Physics and the Physical Society

MANCHESTER
"Spectroscopic Studies Using Time Resolution Techniques": Symposium. Applied Spectroscopy Group—Manchester Branch. Literary and Philosophical Society's lecture hall, George Street, Manchester. Fri., 16 June, 10.30 a.m. and 2.30 p.m.

Institution of Production Engineers

BRISTOL
"Some Aspects of Engineering Progress," by Sir Willis Jackson. The 1961 Viscount Nuffield Paper. Engineering Faculty, The University, Bristol. Wed., 14 June, 6.30 p.m.

Women's Engineering Society

LONDON
Annual General Meeting. London Branch. Hope House, 45 Great Peter Street, Westminster SW1. Wed., 14 June, 7 p.m.

Association of Supervising Electrical Engineers, 23 Bloomsbury Square, London WC1. (LANgham 5927)
Institute of Physics and the Physical Society, 47 Belgrave Square, London SW1. (BELgravia 6111)
Institution of Production Engineers, 10 Chesterfield Street, London W1. (GROsvenor 5254)
Women's Engineering Society, 25 Foubert's Place, London W1. (GERrard 5212)

The European Electric Power Situation

This year Britain will be coupled electrically to the Continent. Partly based on a UN report, this article reveals a certain "equality of misery" in future programming.

By J. H. M. Sykes

As the delegates to Britain's Electrical Power Convention meet at Eastbourne, on the South Coast, they well may be led to discuss the electrical characteristics of their new neighbours; for this year will see the completion of the cross-Channel cable, linking the British grid system for the first time with that of France.

It is interesting to speculate that when the first units flow inwards across the Channel, there will (theoretically) be a direct linkage between all parts of the mainland of the British Isles with networks as far removed as those on the borders of the USSR. France is linked with West Germany, which in turn has fairly substantial electrical links with Austria. From Austria there are power transmission lines running both to Czechoslovakia and Hungary. In 1962 Hungary is to be linked with the Russian networks by means of a double-circuit 220 kV line, and so a potential interchange of power between London and Moscow becomes possible. Of course it is obvious that the various links at present making up the chain between Britain and the edge of the Soviet bloc countries are in many cases not powerful enough to constitute effective international power exchange media: but they are continually being reinforced.

It will be found, when the electrical outlook of Britain's new power partners is examined more closely, that there is a certain "equality of misery" in their viewpoint, when compared with ours.

In Britain there has been a degree of caution in forward planning for electricity supply that goes beyond the natural conservatism of the engineer charged with operating a vital public service, involving the expenditure of £300 million a year.

We have Professor R. S. Edwards, deputy chairman of the Electricty Council, telling us in *Electricity* (Vol. 13, Nov.-Dec. 1960, p. 292) that, "Today, practically the whole of industry and commerce, 95 per cent of the homes and over 80 per cent of the farms are already using the public electricity supply. The rate at which new consumers are connected must soon begin to decline. Therefore, although overall demand is at present rising as briskly as ever, the [electricity supply] industry is working to a generating programme slightly below the trend line, on the assumption that any consistent departure from it is likely to be downwards rather than upwards."

DECELERATION IN DEMAND

The counterpart of this pessimistic view is seen in the annual report on the electric power situation in Europe, prepared by United Nations, Geneva, and relating to 1959-60.

A table giving long term forecasts, up to 1975, for 20 European countries (including the USSR) shows in most cases that a decline in the rate of growth of electrical demand is anticipated. Austria, Norway, Sweden, Britain and the United States (always included in these European surveys for comparison purposes) allow for "a clear deceleration in growth towards 1975."

West Germany (including the Saar), however, boldly assumes that the average rate of increase of demand will rise and not fall.

The British viewpoint, expressed by Professor Edwards and applied to the Generating Boards' programmes for new plant, has already led to somewhat hasty revision in an upward direction of the rate of ordering new plant; and in the winter of 1960-61 there was considerable anxiety as to whether or not the peak could be met.

The United Nations report includes some contradictions. It says, "Taking a long term view, the need to envisage a relative as well as an absolute rise in the apportionment of capital resources to electric energy supply is not a temporary feature but is an inevitable consequence of the fact that consumption (of electrical energy) rises far more quickly than total national product, while economies of scale and technical factors making for increased efficiency and productivity of supply systems can hardly suffice to cancel out this difference."

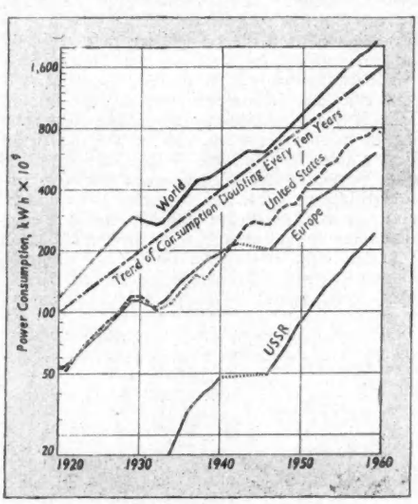
Elsewhere in the report we are told that, "It is also true that both in Europe and the United States there has during the post-war years been a fairly widespread and consistent tendency to under-estimate needs of electric energy . . . Underestimating at a time of rapid economic growth (such as has characterised the post-war period) may arise from reliance on a too-direct correlation with long term tendencies in the rate of total national output." Yet again we find, "It seems probable that to assume a simple association between electric energy requirements and the main general indices of economic growth is to invite the risk of an error in forecasting that at present may lead to an understatement of true requirements."

On the one hand, then, we hear of electricity supply authorities at both ends of the Channel cable taking a cautious and even gloomy view of the probable rate of rise of the demand for electric power over the next 15 years, with the UN statistics partially supporting this viewpoint and partially decrying it; and on the other hand a clear call to spend more capital on power plant, since the demand is said to rise far more rapidly than does the index of total national product. But then we are told that in any case it is unwise to correlate electrical forecasts with economic indices.

Perhaps the clearest pointer to offer to the electricity supply planners in Europe and in Britain is the old and trusted long-term curve of demand, reproduced here.

Ever since electricity supply statistics have been kept a natural law seems to have emerged: the demand will double in ten years. The accompanying graph goes back only as far as 1920: but similar curves have been prepared showing the increase in demand, in particular cases, since 1900.

The UN report has much to say on the means now available to meet the power demands of the next 15 years (whatever they may turn out to be): and some of it is again tinged with pessimism.



Trends in gross consumption of electric power in Europe (excluding the USSR) compared with the world, the USA and the USSR.

A breath of cool air is blown at those who have hoped that nuclear power station progress would have been more rapid.

The leap-frog progress of nuclear power, always seeming to end up one jump behind the progress of conventional power generation, shows no sign as yet of changing its pattern.

Hydro-power is seen to be suffering a decline, in regard to the proportion of hydro-power to thermal power in Europe as a whole.

Excluding the USSR, in the rest of Europe water power accounted for 37 per cent of total power generating in 1938, and only 34 per cent in 1959.

IMPROVED LOAD FACTORS

The bulk of the power needed in the next 15 years in Europe and in Britain will obviously have to be provided by thermal means; and in touching on conventional thermal generation the UN report again has some cautionary undertones.

Mentioning that several countries are actively studying the design of single generating units of up to 800 MW in size, it touches on the economies these units will bring, including those associated with manufacture, reduced operating staff per unit of output, and lowered specific building volume, but these can only be obtained in fully integrated systems with *a high base load* (author's italics). "Higher thermal efficiencies continue to be reached in modern plants by improved steam conditions, but the future rate of improvement in this direction must eventually decline."

There is one bright spot in the UN report, where the greatly increasing extent of European interconnection is noted. The advantages available from large modern steam plants can only be obtained—as noted above in the italicized phrase in the last paragraph—when high base loads are available. This implies improved load factor which is only obtainable by interconnection.

The report shows, in a striking fashion, how the availability of ample electrical interconnection can save a whole country from the serious effects of temporary power shortages.

In Switzerland, in the latter part of 1959, the water inflow to the hydroelectric reservoirs had fallen through low rainfall to a level very much below normal. In addition, there was a considerable rise at that period in the country's consumption of electricity. In place of the exports of hydro-power that would normally have occurred, imports from France, Italy, Western Germany and (through international networks) from Belgium and Holland rose to nearly 10 per cent of the total Swiss needs for power.

The report tells us that, "At the end of 1959 the rapidly converging extra-high-voltage networks in Europe comprised in all about 3800 km (2361 miles) in the different Scandinavian countries, 3560 km (2200 miles) in the United Kingdom, and nearly 2000 km (1240 miles) in continental Europe, with about the same length (2000 km) in the USSR.

These lines, of course, are used in the countries concerned for their own special purpose, such as (in France) ensuring economic usage of the hydro-power in the south in conjunction with the thermal power in the north. But by an extension of the same reasoning that brought them into existence, they can be of great service to the electrical power economy of any country or countries where difficult conditions arise—or perhaps where timid planners have left a heritage of inadequate generating capacity.

If Britain Joins in the Common Market

Engineering industries are likely to be among those principally affected should Britain enter the Common Market. In such case, tariff concessions may well considerably expand the country's exports.

By Richard Bailey

SUGGESTIONS that Britain will join the Common Market have now been accepted by large sections of British industry. The actual form of agreement and the derogations that will be obtained from the Rome Treaty to cover the major problems are still matters for negotiation. What arrangements will be made for British trade with the Commonwealth and the European Free Trade Association (the EFTA), and how British agriculture will be supported, are matters which the politicians have to work out. But, so far as industry is concerned, the general pattern of trade and manufacturing in the Common Market is by now fairly clear.

TARIFF CHANGES

The Rome Treaty set out a programme of tariff reductions spread over a period of 12 to 15 years. This reduction, however, has already been overtaken by events. The Six have reduced their tariffs on trade within the Common Market by three cuts of 10 per cent each. A further cut of 10 per cent is proposed for 1 January, 1962, but this reduction may be increased to 20 per cent. It is difficult to say how fast the remaining cuts will be made but it is possible that all tariffs on trade between members will have been abolished by 1966. Apart from reducing tariffs on trade between themselves, the Six made the first moves towards setting up a common tariff against outside countries on 1 January of this year. The effect of this action was to bring down Italian and French duties and to raise those of Germany and the Benelux countries towards the common external tariff, which is calculated on the average of the existing tariffs of the Six. The next move towards the common external tariff is due to be taken at the end of 1965.

The important facts about the six-nation Common Market are its size and the variety of goods it can absorb. The aggregate population of the six member countries—France, Germany, Italy, Holland, Belgium and Luxembourg—is over 170 million people. If Britain joined, the total would go up to 220 million. But size is not everything, as the Indian and Chinese markets demonstrate. The people in the Common Market countries have high living standards which can mean a dramatic expansion of imports of manufactured goods.

As to Britain's share of the increased imports of the Common Market nations, about half of the total imports of manufactured goods result from intra-EEC trade; one-tenth come from the United Kingdom and another tenth from the United States. On the whole, this performance of British manufactured goods has been disappointing. Exports from the United Kingdom into the Six rose by 17 per cent between 1956 and 1959. At the same time, imports from all sources into EEC went up by 27 per cent, and those from intra-EEC trade by 35 per cent.

In the list of British exports to the Common Market, some engineering products have done fairly well, as the accompanying table shows.

PATTERN BY INDUSTRIES

The opportunities for exporting engineering products to the Six naturally vary by industries and by countries. In heavy engineering, the boom conditions prevailing in the Common Market countries, especially in Italy, Germany and France make import prospects particularly favourable. If, on top of this, Britain were to benefit from tariff reductions, the results could be extremely good, provided satisfactory credit terms and delivery dates could be arranged. The steel industry, with prices on the whole below those of the Six, could compete without any difficulty.

Among metal manufactures, which cover a whole range of products, including cables, steel girders, metal windows and nuts and bolts, there are considerable tariff advantages to be gained. Wire cables, for example, will carry a duty of 13 per cent when the common external tariff comes into operation. This duty compares with 8 per cent and 10 per cent under the national tariffs of West Germany and the Benelux countries respectively, Britain's best customers among the Six. Other items in this section, on which the common external tariff levels will be fairly stiff, are steel barrels (14 per cent), iron and steel bolts (17 per cent), aluminium hollow ware (21 per cent), files and rasps (13 per cent) and scissors (17 per cent). In all these cases, there is clearly scope for increased exports given tariff equality.

Non-electric machinery is one of the categories in which British exports to the Common Market are already considerable in respect to some items. The common tariff on the majority of all kinds of non-electric machinery will be between 11 and 25 per cent. At the present time, the best sellers are power generating machinery and metal-working machines. In 1958, the Six EEC countries imported £266 million worth of non-electric machinery from Britain, of which about one-quarter paid tariff duties of 15 per cent or over. There can be little doubt that, if Britain stayed outside the Common Market, a considerable diversion of trade in non-electric machinery would take place.

In machine tools, the prospects are probably better for the more expensive tools constructed to fit special requirements. On small mass-produced machine tools, there are complaints that British designs are sometimes clumsy and more robust than is necessary to do the job. Indeed, this is a sector where the complaint tends to be that quality is unnecessarily high. The common tariff will be of the order of 5 to 13 per cent according to type. The chances of increased trade as a result of entry into the Common Market will depend to a great extent upon Britain's ability to keep delivery dates and give adequate after-sales service. Those firms which already have a foothold in the Common Market should expand rapidly. But small firms, with no experience of selling in Europe, will find the going hard and probably expensive.

The development of the automobile industry is problematical. Competition inside the Common Market will undoubtedly be severe, especially in the small-car group. Here, the policy of Renault, Volkswagen and Fiat of concentrating on a particular model, has made possible considerable economies. For more expensive models, and particularly sports cars, British manufacturers could find a sales drive in the Common Market most rewarding. With the common external tariff of 29 per cent removed, British sports cars would be highly competitive. An important factor is that the Six have a road system on which these cars can be given a chance to show their paces.

In electric machinery, the majority of items in the common tariff lie between 14 per cent and 20 per cent. This rate is on the whole above the German and Benelux rates, which have been Britain's best customers among the Six. The main competition in the Common Market would be from Germany and France. The French electrical-engineering industry is much more dependent on its home market than is that of Britain or Germany.

On the heavier and more expensive items, such as generating plant, there have been frequent reports that Continental firms are able to offer longer and easier credit facilities. On the whole, the big firms turning out mass-produced appliances should find considerable opportunities in the Common Market. Differences of design may raise short-term problems.

United Kingdom Exports to the Common Market in 1959

(Dollars, millions per month. Percentage share from the UK in brackets)

Non-electric machinery	
Tractors	5·6 (36)
Power-generating	24·0 (20)
Office	11·1 (9)
Agricultural	5·3 (9)
Metalworking	14·3 (8)
Other	81·0 (14)
Transport equipment	
Aircraft	14·0 (24)
Road motor vehicles	45·0 (10)
Other road vehicles	1·9 (19)
Ships and boats	8·4 (8)
Railway vehicles	1·7 (4)

Source: *Treasury Bulletin for Industry*, April 1961.

NATIONAL DIFFERENCES COUNT

Although the Common Market will be a single unit for tariff purposes, it does not follow that the same product will sell equally well in Bremen, Bari and Biarritz. The removal of the tariffs against British goods, which would follow the entry of the United Kingdom into the Common Market is only a letting-off of the brakes. Sales efforts, specially directed to each particular part of the market, will be necessary if firms are to profit from the opportunities offered by freer trade. Western Europe is described in the report of the Export Council for Europe as "one of the most exciting and promising markets in the World—rich, sophisticated and discriminating". Such a market is only to be won by firms producing the right goods at the right time and place.

A great deal of very useful information is readily available on this subject. The *Board of Trade Journal* has published a series of articles on the opportunities for British exporters in the Common Market. These expositions appeared in the journal as follows: France (3 March) Germany (24 March) Holland (7 April) Belgium and Luxembourg (21 April) and Italy (28 April). The articles give details of past performance, make suggestions for action, name the main trade associations, give particulars of trade fairs and market research organizations, and, most important of all, give the names and addresses of officials able to supply further information.

The present article has examined the consequences for the engineering industry if Britain joins the European Economic Community. At this moment, no negotiations to bring this about are actually taking place. The United Kingdom is engaging in talks at official level with the governments of the Six as well as with those of the Commonwealth and European Free Trade Area countries. The Prime Minister stated at the meeting of the Assembly of the Western European Union in London on 29 May that the Government wanted to see an end to the division in Europe.

Many difficulties, notably the treatment of Commonwealth products, of British agriculture and Britain's relations with the EFTA remain to be solved. But, whatever shape the pattern of trade set up in Western Europe eventually takes, whether Britain alone joins the EEC, or whether a number of the other EFTA countries go along too, there is no doubt that the EEC market offers excellent prospects. In the post-war years, the big increases in trade have been between industrial countries. The division of Europe between the Six and Seven would check this process so far as Western Europe is concerned, and lead to considerable trade diversions in a number of important engineering products.

Human Element

Skilled Job Opportunities Still Too Low

BRITAIN'S working population rose by 300,000 in the course of last year, to the record number of 24,600,000. More than half-a-million young people left school and started work, almost all finding their first full-time job within a matter of weeks.

Despite this picture of abounding work and opportunities, there was only a slight increase in the number of boys and girls going into skilled occupations. In 1959, from a marginally greater number of school leavers, 119,000 (20·8 per cent) had gone into skilled work. Last year, the number increased to 123,000 (22·4 per cent).

Movements within the manufacturing industries reflect the changing degrees of prosperity. Although shipyard closures or general dismissals of workers have not yet been forced on the shipbuilding industry by the severe lack of new orders, there was a significant fall in the shipbuilding and repairing labour force, by 11,000 to a total to 177,000.

In the thriving machine-tool companies, the numbers employed went up from 84,000 to 90,000. The rather general engineering, electrical goods and vehicles group kept up a high level of employment and had risen by the end of the year to 2,979,000, an increase of 110,000 persons.

An interesting position is reflected in the motor-vehicle group, whose labour force was 413,000 last September, moved up to 439,000 by September, and at the end of the year, by non-replacement of wastage and redundancy dismissals, had declined again to 419,000. This is a position which has undergone a considerable change since the return of the home demand in the spring and the upturn in overseas sales.

Short Time and Overtime

At the end of the year, the number of persons on short time working had gone up to 139,000. More than half of this total, 71,000, were employed in car-producing companies; yet, at the same time, there were 80,000 people working overtime in the motor-vehicle manufacturing group.

In two nationalized industries, coal and British Railways, the manpower situation showed a quite different picture. No fewer than 35 collieries were shut down and abnormally high wastage continued, with the result that there was a fall in the coalmining labour force from 727,900 at the start of the year to 675,200 at the close.

The need for more railway operating staff became even more acute than it had been. Against the trend of the bad summer weather, the numbers in catering increased to a new peak, in July, of 601,000.

Unemployment fell substantially over the year but remained well above the national average in a number of areas —in Scotland, Wales and North-East England, where the problem continued extremely intractable. These areas experienced some improvement in their employment position, though not enough to bring them into line with the general position of high employment.

At the end of the year, there were 365,000 persons unemployed, a reduction of 56,000 over the twelve months. The monthly average was 360,000, made up of 260,000 men and boys and 100,000 women and girls.

Almost every industry was conducting negotiations between employers and workers' representatives for shorter hours, without loss of pay, or for wage increases, or quite often for both.

Since 1950, the number of stoppages in industry had been rising until the trend was broken in 1958 and 1959. The upward movement was resumed last year, when the number, 2,797, was notably above the average for the previous ten years. Two-thirds of the total of stoppages were in the coalmining industry (1,644). The engineering, motor vehicles, construction and the docks industries all had above the average number of strikes.

Time lost by disputes during the year was 3,008,000 days. In 1959, the total had been 5,270,000 days, but 3,500,000 of those were lost in the printing industry's strike.

And, at the Ministry of Labour itself, the number of its staff fell from 22,112 to 20,811, chiefly due to the fall in the number of unemployed and the run down of work following the end of National Service.

Report of the Ministry of Labour 1960 (HM Stationery Office, 7*s*).

Regional Committees in Industrial Training

Nine regional committees in England and a committee each for Scotland and Wales have been set up by the Industrial Training Council to keep under review and to encourage the recruitment and training of young people over the next three years, when increasing numbers of youngsters will be leaving school.

The regional committee have been set up following the recent area conferences. They are made up of representatives nominated by the British Employers' Confederation, the Trades Union Congress, and the Nationalised Industries.

So far the work of the Industrial Training Council on the opportunities presented by the greater number of young people leaving school has been through employers' organizations and trade unions on an industrial and not a regional basis.

The committees will be advisors to the Council, keeping its information on what is happening in the regions up to date and, where necessary, serving as a link within the region between the local industrial organizations. In some cases it may be possible for the committees to carry the work of the Training Advisory Service of the ITC further by advising on sources of work and by helping to publicise the service.

Chairmen of Regional Committees

Region	*Chairman*
London and South Eastern	Mr. F. Hayday, National Industrial Officer, National Union of General and Municipal Workers
Midland	Mr. F. Garner, Deputy Managing Director, Joseph Lucas (Industries) Limited, Birmingham. President, Birmingham Engineering Employers' Association
North Midland	Mr. G. E. Dearing, M.B.E., General Secretary, National Union of Hosiery Workers
North Western	Mr. L. T. Wright, General Secretary, Amalgamated Weavers Association
Scotland	Mr. James Anderson, M.B.E., Managing Director, Anderson Boyes & Co., Motherwell; President, Scottish Engineering Employers' Association
Southern	Mr. A. F. Hetherington, D.S.C., Deputy Chairman, Southern Gas Board
Wales	Mr. A. J. Nicholas, Managing Director, South Wales Switchgear Limited, Blackwood, Mon.
East and West Ridings	Mr. A. King, O.B.E., Divisional Organiser, Amalgamated Engineering Union
Northern	Mr. F. B. George, Managing Director, Consett Iron Company Limited, Co. Durham
South Western	Mr. N. G. Cadman, Director and General Manager, Westinghouse Brake and Signal Company, Chippenham
Eastern	Mr. H. B. Pugh, Chairman, Eastern Electricity Board

First FBI Woman Student a Marine Engineer

A small, but select, part of the United Kingdom's activity in furthering engineering education abroad is the Federation of British Industries' Scholarships Scheme. The principle of the scheme is that engineers who have taken their degree are brought to engineering companies in the United Kingdom for further training before returning to their home countries.

There have now been some 430 FBI scholars and the progress made by the first one of all is instructive of the sort of thing that can often happen to an engineer returning to a fast developing country. Back in 1950, the first scholar, Mr. E. Friedman, landed from Santiago, Chile. After his British training he returned home to build his career. He is now chief of the Chilean Office of Nuclear Engineering and of the Planning Division for Electrical Systems.

Celebrating its tenth anniversary earlier this year, the scheme now has its first woman scholar, Miss Carmen F. Perez Menendez, of Argentina. A graduate of Buenos Aires University in naval architecture, marine engineering and civil engineering (a six-year course), Miss Menendez is now training at the naval construction works of Vickers-Armstrongs (Engineers) Limited at Barrow-in-Furness.

Women engineers are apparently much more common in Argentina than in Britain and in the chemical engineering university departments outnumber the male students by three to one.

A Post Graduate Course in Chemical Engineering

The Institution of Chemical Engineers has now brought out a scheme for a post-graduate course in chemical engineering which should lead to something like the attention being directed to this form of further training that has, since the end of the Second World War, been given to chemical engineering primary degree courses.

The Institution are very much aware that in the early history of chemical engineering courses, post-graduate education was the most common, being designed to enable chemists and engineers to qualify in chemical engineering.

In practice, the syllabus put forward amounts to two courses, a supplementary course in chemistry or mechanical engineering for either mechanical engineers or chemists, followed up with a general course in chemical engineering. A good second class honours degree from a United Kingdom university, or the equivalent, is expected. In addition chemistry graduates should have done mathematics, and mechanical engineering graduates, chemistry, as an extra subject to at least advanced GCE level.

An outline of subjects for the one year post-graduate course, gives engineering drawing and design and the study of power plant for chemists; inorganic and organic chemistry followed by physical chemistry for engineers. From then on the two streams converge and the order of subjects goes:

Fluid and particle mechanics
Heat and mass transfer
Separation processes and reactors
Materials of construction
Design problems.

A National Wage Policy for the United Kingdom?

The recommendations of six economists who prepared the report *The Problem of Rising Prices* for OEEC (the Organisation for European Economic Cooperation) run, on one important issue, in what looks like the opposite direction to the way things have been allowed to develop in the United Kingdom.

Four of the six authors suggest national wages policies even though this may be opposed by widely accepted and traditional views of the manner in which collective bargaining is best carried on. In Britain the application of the principle that civil servants and certain nationalized industries' employees should have wage rates comparable with outside industry means that to that extent the Government abandons its wage control in an influential sector of the economy.

That a large and powerful part of the existing machinery of wage settlement should be beyond the reach of official stabilising policy is believed by a majority of the authors to be not something governments can allow. On attempts to restrain inflation by holding down demand, the authors point to the all too well known possibility of serious restraint causing unemployment and failure to grow while failing to stop the ascent of wages and prices.

What do these economists, one of them the former Director of Economics in the OEEC and the others all professors, mean by a wages policy? The answer is a suitably exact knowledge of the average wages increase that is appropriate with price stability in a given economic situation. The action to be taken is at least that of making it known to all those concerned, and gathering support for the achievement of its objectives. This sounds rather more like a national wages persuasion policy but the report certainly does not regard simple exhortation to the unions to exercise wage restraint as a viable form of wage policy.

In examining the causes of inflation, the report points out that too large wage increases are a separate cause from that of excess demands. The national wages policy is advanced as a remedy for the first; more flexible fiscal action, as shown in the recent Budget, for the second.

Mechanical Aids on Site

The use of plant on construction sites has grown at a great rate over the last fifteen years. Developments in the machines are keeping abreast of requirements, but there is no sign of long term research.

It is only a little more than ten years since the first tower crane was brought into the United Kingdom. And it is only some 20 years since the first concrete road-laying trains were used in the country. The familiar sight of both these types of constructional equipment is a measure of the growth in the use of mechanical plant on civil engineering sites—and of the reduction in the labour force. It is now not unknown for plant valued at over £1 million to be assembled for a single contract. Only by such an intensive and economic use of machines can the constructional industries meet the increasing demands placed upon them.

The construction equipment manufacturers represent a great engineering industry and in Britain have a combined output of over £100 million a year. It is also a great export industry and for the past year exports have been running at 50 per cent, representing £1 million of plant sent overseas every week.

Though the British construction equipment industry has undoubtedly been successful in its assessment of the current requirements of the civil engineering and building industries there seems little sign of any far reaching thinking about machines for the future. In the last two years the draw-bar pull of the largest tractors has doubled. Such a rate of growth can only mean that a new form of tractor will have to be developed, yet there appears to be no organization—apart from already hard pressed design offices of existing firms—that can consider such a project. There are signs that, elsewhere, fundamentally different machines are contemplated and it will not be sufficient for British firms to take out licences on overseas patents to maintain a good export record.

There is, however, some good development work going on and several manufacturers are taking advantage of the proving tests on civil plant now being conducted by the Military Engineering Experimental Establishment (MEXE) at Christchurch. Some details of the MEXE scheme, which has been prepared in conjunction with the Federation of Manufacturers of Construction Equipment (FMCE), are given below, but the more significant part of the work is the advisory tests that are undertaken; in these tests, experienced examiners put equipment through its paces and indicate the points of potential weakness.

GROWTH FACTORS

Constructional equipment has multiplied in recent years. The time is long past when the pump, the mechanical excavator, the concrete mixer—and the smooth wheel roller—were the unrivalled examples of site plant. Cement now comes in tankers and is stored in silos; concrete is made in batching plants, or brought to the site ready mixed—a recent report showed that on one building site in London over 1,200 cu. yd of pre-mixed concrete was delivered and placed in one working shift. Excavating machinery has grown in capacity in a most extraordinary fashion, based mainly on the crawler tractor, though the wheeled tractor, with its greater speed and mobility in all but the most sticky of conditions, seems to be coming well to the fore. Compaction plant too now comprises many types of plant, as the table on the opposite page shows, though the smooth wheel roller still possesses the advantage of being the cheapest to operate under a wide range of conditions. Compressed air is almost a universal form of power for many of the heavier hand tools though the experience of the electric tool makers must soon take them into the compressed air field.

But in no field can the rate of growth been so fast as in handling machines. Faster work and a smaller labour force have gone hand in hand; costs have not gone down but time has been bought. A valuable contribution to progress in mechanization of building operations has come from the Building Research Station, particularly the mechanization division, under Mr. J. F. Eden.

The trend towards greater mechanization in the building industry in Britain began after the Second World War when the major part of the country's building industry was involved in the rapid erection of small houses. Three pieces of equipment came into being to counter the inherent slowness of the traditional methods of house building. They were the tractor-mounted digger with a small bucket for cutting trenches for foundation and drains; small three and four-wheeled powered barrows for carrying concrete from the mixer and tipping it into the foundations —this was a British innovation that has proved successful all over the world; and the third piece of equipment was the mobile hoist, free-standing to heights of 20 ft (and extendable to greater heights if tied to the building) able to be moved and erected in a matter of minutes. Similar in purpose to the powered wheel barrows, and also very successful both for house building and more general construction sites, is the Monorail transporter.

TOWER CRANES AND HOISTS

Remarkable in the last ten years has been the number of multi-storey buildings that have gone up. It is perhaps an arguable point which came first, the need and desire for tall buildings or the plant that enabled them to be built economically.

The principal machines in this respect came from Europe, the tower crane and the climbing crane. Though introduced originally because of their height, 100 ft and more, the building industry was very quick to utilize the advantage of the long boom which provides a materials handling device covering the whole of the site in manner far superior to that offered by any other piece of plant. It is not only for housing, flats and office blocks that tower cranes have proved beneficial: in bridge work they have proved useful both in cases where the bridge deck has been high above the route by which materials have arrived at the site and where their long reach has enabled the whole deck to be covered from one advantageous point.

Arising from the use of light cranes on site has been the very successful exploitation of pre-cast concrete units in large buildings. For one recently let contract, a £1¼ million housing development in Glasgow comprising 400 maisonettes in ten 20 storey blocks, plant valued at over £100,000, including four large tower cranes, will be used. The contractor — Holland & Hannen and Cubitts—is importing one of the largest mobile tower cranes ever employed in the United Kingdom. It is able to lift loads of 4½ tons to a height of 210 ft at a radius of 100 ft and its main task will be to lift into place 800 wall panels, each 21 ft by 9 ft, straight from the lorries which bring them from the factory where they will be precast. Each panel will weigh 4 tons.

Two marks of the progress made by pre-fabrication come from the same contract. Only 10,000 bricks will be used on the whole project, and they will be required for manhole construction not in the buildings themselves, and over 600 precast flights of stairs will be put into place in the flats. During construction, access to the higher floors for workmen (at peak there will be only 350 men on the job) and small tools will be by two passenger/access hoists.

The need for the hoists points out two of the limitations of tower cranes and other similar equipment. In the first place no crane can feed men or materials between the previously constructed floors of a building and, in Great Britain, no crane can be used for carrying men. Thus, for raising men and materials required for finishing tall buildings, a hoist is essential. There is a British-made hoist that can be quickly erected within a prefabricated tower to heights of 400 ft or more. It complies in all respects with the most stringent safety regulations and two such hoists have been used recently in the construction of the main 500 ft high towers for the Forth Road Bridge.

A few years ago work at the Building Research Station led to quicker methods of handling bricks. The bricks are made up at the makers into packs of 50 bound with a steel tape. These packs travel better, with fewer breakages, and are easily unloaded on to purpose designed barrows for movement about the site or to the foot of the hoist. Lorry turn-round is quicker than with loose bricks and less time and labour is used on the site in handling the bricks which, in these steel bound packs, are more readily stored.

Concrete pumps for conveying the mix from the batching plant to the point of placing do not seem to have been so successful as they at one time promised. Cleaning and flushing of the piping is not always easy to arrange and this may have been the concrete pumps' largest drawback. The stiffer mixes now used cannot have increased the life of the pumps. Overlapping conveyor belts seem to be making considerable progress, but most popular still seems to be the powered barrow on the smaller site and dumper trucks, in a wide range of sizes, on the larger sites.

For road work the most popular excavation equipment is undoubtedly the tractor/scraper combination. Very high speeds of working can be obtained with rubber-wheeled units and, where conditions get too bad, there are crawler tractors in the 200 to 300 hp range designed specifically for push loading. In a recent paper* it was said that improvements in bulk excavating plant have kept pace with rising costs so that unit costs have not changed very much over the last ten years. Rock excavation, especially where it is too thin for drilling and blasting, is also best tackled with the larger crawler tractors equipped with rear mounted rippers; by the additional use of a pusher tractor, sufficient load can be brought to bear that will break up many rocks so that the spoil can be loaded away by tractor hauled scrapers. Where the rock is found in well defined layers of less than 12 in thickness, ripping of even hard rocks can usually be carried out without the assistance of the second tractor and costs can be kept below those of drilling and blasting.

CONCRETE TRAINS

In both airfield and road construction, extensive use is now made of rolled lean concrete as the base course. Because of the uncertainty of the climate in Britain, mixed-in-place stabilized soil has not proved generally successful, though at least one very good piece of plant for this work is made in the country and some individual engineers have used the technique with advantage. On the other hand, less difficulties have been experienced with plant-mixed lean concretes. Normal mixing methods can be used unless the aggregate is very loamy and this difficulty can be overcome with suitable plant.

Laying of the top concrete pavement has developed two main techniques: either central batch mixing of the concrete which is transported to the point of use ready for placing, or the dry aggregates are pre-mixed and taken to mobile mixers where the water is added. Both these methods are used in conjunction with a train of machines which spread, compact, finish and lay

* E. U. Broadbent and M. A. May, "The Use of Specialized Plant on Airfield and Road Construction" Institution of Civil Engineers, paper No. 6464, presented 18 April, 1961.

a curing coat. In order to obtain the riding quality now called for—measured as an irregularity coefficient of so many inches per mile—satisfactory methods of aligning and fixing the formwork, for the maximum variation now permitted on trunkroads and runways is only $\frac{1}{8}$ in under a 10 ft straight-edge laid in any direction.

In general it has not proved possible to make and fix the formwork to the required tolerances and improvements have been obtained in the spreading and compacting machines. In particular a successful method has involved mounting the finishing bar, which tamps the final top surface of the concrete, at the middle of a long chassis so that it does not directly reproduce the irregularities of the screeds but evens out the faults. Another method, originating in America, is the use of a longitudinal finishing bar which is mounted in a frame having wheel centres at 16 ft. As the frame moves forward over the new road surface, the bar traverses the width of the road. This too has the effect of evening out local faults in the formwork and is particularly effective in correctly finishing any cross-fall to which the concrete may be laid, overcoming the down-hill flow that occurs under the influence of the vibrators.

The emphasis in both airfield and road construction is on speed of construction combined with the demand to achieve a good riding surface, and in the paper already referred to the authors listed a number of problems still requiring development. The more important of these required the improvement of the plant used and were as follows:—

(1) techniques for maintaining progress through the widest possible variations of weather and soil conditions, especially in relation to the compaction of soils; and

(2) plant for laying, grading, and compacting granular sub-bases and bases.

PROVING CIVIL PLANT

The proving tests now being conducted at the Military Engineering Experimental Establishment at Christchurch have already been mentioned. Working in conjunction with the Federation of Manufacturers of Construction Equipment, MEXE have become the British testing authority for civil plant. The principal tests undertaken are made to show that the machines satisfy the makers' codes that, wherever possible, conform to British Standards or to codes that are devised by the FMCE. The facilities and methods of testing at Christchurch have already been described in ENGINEERING (1 April, '60, p. 443) though since then some extensions have been put in hand. Better methods of noise measurement, especially noise analysis, have been adopted; a prying-out rig has been built so that the perpendicular pull at the lip of loading bucket can be accurately measured; and an all-weather facility is being built that will enable MEXE to conduct 10 hour tests on the largest available tractors. For this test a new road, laid in the form of a figure of eight is being constructed, one lane for crawler tractors and a second for wheeled tractors. An especially soft surface has been contrived that can be readily and continuously remade so that consistent conditions can be maintained.

Proving tests of the type mentioned above are carried out on production machines but a valuable additional service is provided by the MEXE Advisory Service Scheme for the testing of prototype machines. This work is completely confidential between the establishment and the manufacturer concerned. It is from such tests as these that real improvements in the design of a machine can be made.

The first civil proving test at MEXE was made in June, 1960, on a loading shovel. To date 15 proving tests to codes have been made: seven on crawler tractors, seven on shovels and one on a scraper. In addition ten advisory tests have been made: three on fork lift trucks, five on shovels, one on a crusher, and one on tyre for construction plant use. From these tests a total of 280 recommendations have been made to the makers concerned.

Cost Trials on Compaction Machines

The performance of most types of compaction plant available to engineers in the United Kingdom has been studied at the Road Research Laboratory under controlled conditions. The results of the work are summarized in the following table.

Apart from conditions of soft wet clay and, more important, well graded sand, the 8 ton smooth-wheeled roller proves to be a most attractive item of plant, able to work all other soil types, at a cost of only a penny for 1 cu. yd of compacted soil. All the data in the table were obtained by using the plant to compact various carefully selected and controlled soil samples in soil pits built for the purpose at the Laboratory at Harmondsworth, Middlesex.

From the data, it is possible to select the most suitable piece of plant for any given site conditions, the number of passes of the plant required, and the thickness of the layers of soil to be used to obtain a satisfactory state of compaction at minimum cost.

Average Possible Outputs of Plant and Costs per Cubic Yard of Compacted Soil

Type of plant	Approx. hourly cost, including hire, wages of operator and fuel	Average output of plant						Cost per cu. yd of compacted soil	Soil types and conditions for which the plant is suitable
		Width compacted by plant	Speed of rolling	Number of passes required	Area compacted per hour	Depth of compacted layer	Output of compacted soil per hour		
	s d	In	Ft per min		Sq. yd	In	Cu. yd	Pence	
2½ ton smooth-wheeled roller	14 6	51	180	8	530	5	74	2·4	Suitable for most soil types under moisture conditions of the British Isles
8 ton smooth-wheeled roller	20 0	70	180	4	1,460	6	243	1·0	Suitable for all soil types except soft wet clay and uniformly graded sand
13½ ton grid roller with 80 hp tracklaying tractor	65 0	62	440	7	1,800	8	400	2·0	Suitable for all types of soil over wide range of moisture conditions by adjustment of ballast
13½ ton grid roller with 150 hp wheeled tractor	80 0	62	880	8	3,160	8	700	1·4	See remarks above but with the qualification that this combination is not suitable for uniformly graded sand or soils in very wet conditions
12 ton pneumatic tyred roller	45 0	82	200	4	1,900	5	264	2·0	Suitable for most types of soil under moisture conditions of British Isles, and particularly wet cohesive materials
20 ton pneumatic tyred roller	60 0	84	200	4	1,940	6	323	2·2	Suitable for most types of soil over wide range of moisture conditions by adjustment of ballast and tyre pressure
45 ton pneumatic tyred roller	105 0	93	200	3	2,870	10	800	1·6	See comments for 20 ton pneumatic tyred roller
2 cwt power rammer	8 6	0·49 Area in sq. ft	60 Blows per min	6 Blows	27	6	4·5	23·0	Suitable for the reinstatement of trenches and compaction in confined areas of all soil types
12 cwt frog rammer	13 6	4·6 Area in sq. ft	50 Blows per min	12 Blows	106	12	35	4·6	Suitable for the reinstatement of large trenches of all soil types
4 cwt vibrating roller	6 6	24	30 hand propelled	8	42	3	3·5	22·0	Suitable for granular soils only
6½ cwt vibratting roller	8 6	28	60	12	65	6	11	9·4	Suitable for granular soils only
19½ cwt tandem vibrating roller	11 0	32	67	4	248	6	41	3·2	Suitable for granular soils only with the exception of uniformly graded sand
3½ ton towed vibrating roller	35 0	72	120	6	670	10	185	2·3	Suitable for all soil types
3½ ton tandem vibrating roller	18 0	39	65	4	293	7	57	3·8	Suitable for all soil types except uniformly graded sands
4 cwt vibrating-plate compactor	10 6	15	28	3	65	6	11	12	Suitable for granular soils only
13 cwt vibrating-plate compactor	12 6	24	53	4	148	8	33	4·6	Suitable for most soil types
14 cwt vibrating-plate compactor	12 6	24	42	2	233	6	39	3·8	Suitable for most soil types except heavy clay
1½ ton vibrating-plate compactor	17 0	30	25	2	174	12	58	3·5	Suitable for most soil types
2 ton vibrating-plate compactor	17 0	34	27	2	213	12	71	2·9	Suitable for most soil types except heavy clay
40 hp tracklaying tractor	35 0	30	350	6	810	6	135	3·1	Suitable for most soil types when no normal compaction plant is available
80 hp tracklaying tractor	55 0	40	440	6	1,360	6	227	2·9	Suitable for most soil types when no normal compaction plant is available

INTERNATIONAL CONSTRUCTION EQUIPMENT EXHIBITION

Crystal Palace, London 15 — 24 June

IT IS perhaps appropriate that a new venture in exhibitions should use—and be the first major exhibition for twenty five years to do so—the site of one of the most well remembered exhibitions of all, the Crystal Palace. Part of the scheme prepared by the London County Council to utilize the site included provision for just such an exhibition; on the rest of the 200 acre site there are to be a recreation centre, a public park with zoo, and a motor cycle racing track.

The best idea of the practicability of construction equipment can be obtained by seeing it in use. At the Crystal Palace two areas have been set aside as proving grounds and both have a 300 ft Bailey bridge over them for observation purposes. This is one of the advantages of a terraced site. The heaviest exhibits will be on the upper terraces and the lighter ones on the others; fifty exhibitors are expected to be using the proving grounds at one time or another. In all, over 170 companies have taken stands and eight overseas firms are going to be present.

The site can be reached by rail using the old "Low Level" station or by special bus from Charing Cross; the old "High Level" station has been demolished to make a car park for 1,500 vehicles. Organization of the exhibition is in the hands of Industrial and Trade Fairs Limited, and the promoters are a new company called Construction Equipment Exhibitions. Some of the items on display are described on this and the next two pages.

SHOVEL LOADER

Four Wheel Drive

SPEEDY operation is one of the claims for the Loadmaster 1000 shovel loader.

The machine has a tractive force of 10,700 lb and a pryout force of the scoop at the toe plate of 13,800 lb. Power is supplied by a four cylinder diesel engine developing 61·5 hp at 2,250 rpm. This drives through a torque convertor with a stall ratio of 2·35 to 1 with power shift for the travel gearbox. There are four speeds available in both directions using transfer gears ranging from 4·45 to 20·4 mph. Hydraulic brakes operate on all four wheels, with vacuum servo assistance. Steering is also servo assisted.

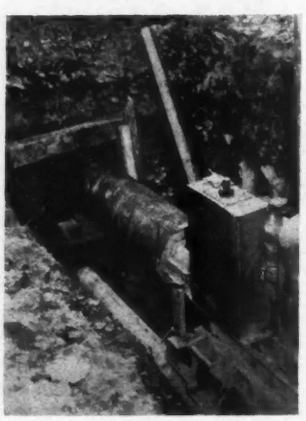
The hydraulic gear pump is driven from the transmission and supplies the two 5 in lift jacks and the two 5 in scoop jacks, wearing spares being identical for both. Relief pressure is 1,200-1,250 lb per sq. in. The side arms are 1½ in thick steel members and all pivot points are bushed with replaceable manganese steel bushes.

With a capacity of 1½ cu. yd the standard scoop has an angle of crowd of 45° and angle of tip fully raised of 45° also. The maximum discharge height is 9 ft 6 in. Lifting time is 7½ seconds and tipping time 2½ seconds. The maximum lift force is 12,200 lb. Alternative scoops are available for rock and for lightweight materials.

The turning radius of the shovel is 20 ft at the extreme outside and 12 ft 6 in inside. The cab is arranged to give all-round visibility and has a windscreen wiper fitted as standard. A heater-ventilator and demister can also be fitted. *Chaseside Engineering Company Limited, Hertford.*

EARTH BORER

For Underground Pipes



NOW to be made in this country is the Salem range of earth borers for laying underground pipes without disturbing the surface.

The machine assembly operates from a trench dug at the side of the road or other obstacle to be underpassed. Auger sections are lowered on the frame and coupled to the driving shaft. Power to rotate the auger is supplied by a Ford 592E diesel engine in the standard models, driving through a clutch, a four-speed box, and a 7 to 1 reduction gear. A gear pump driven from the power take-off supplies power to the hydraulic rams that push the auger and casing forward as the drilling proceeds. As each section is driven into the earth the drive unit is retracted and a new auger section added. In this way holes up to 250 ft long have been bored in one operation.

There are three standard sizes in the range, the 12TD, 16TD and 24TD, which will respectively take augers up to 12 in, 16 in and 24 in diameter. By using a back reamer attachment it is possible to bore holes up to 48 in diameter. Auger sections are 6 ft long and various types of head are available. Forward stroke is 8 ft and maximum thrust in the largest model is 30,000 lb. *F. Taylor and Sons (Manchester) Limited, Salford, Lancashire.*

CRAWLER TRACTOR

Responsive and Manoeuvrable

PIONEERING and clearing, dozing, slope work, push-loading, stripping, ripping, logging and grading are jobs for which the Euclid C-6 Crawler Tractor is designed.

The C-6 is powered by a Cummins engine rated at 2,100 rpm. The drive is through an Allison torque converter and Allison transmission giving forward and reverse speeds from 0 to 8·6 mph through three gear ranges. Shifting from one speed range to another, or between forward and reverse, can be done under full power while the tractor is in motion with no stop involved for clutching. This power train provides simple operation and a smooth steady flow of power for all job requirements.

Steering is by oil-cooled multiple disc clutches and multiple disc brakes. A feathering effect of power on the track on the inside of a turn is available, as well as partial or complete braking—thus maintaining positive control. In-seat electric starting is provided. An efficient dry air cleaner reduces engine wear and increases life. The rear-mounted radiator gives effective cooling with dust free operation.

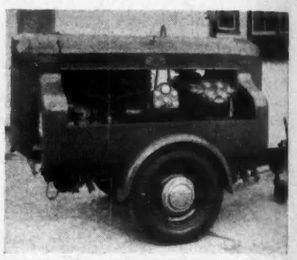
Simplified controls together with good all-round visibility are further operating advantages.

The frame is of heavy, welded construction providing a rugged backbone for the tractor. A heavy duty nose guard protects engine and power control unit. With vertical and lateral support at front and rear, superior track alignment is obtained. The track tensioning and recoil system is hydraulic instead of mechanical.

The bare operating weight of the tractor is 44,580 lb. Overall length is 191·2 in, overall width 100 in and height exclusive of exhaust stack 96·75 in. The fuel tanks hold 100 gallons. *Euclid (Great Britain) Limited, Newhouse Industrial Estate, Motherwell, Lanarkshire.*

PORTABLE AIR COMPRESSOR

For High Speed Towing



COMPRESSED air requirements for 4-5 tools or pile driving are met by the compact two-wheel trailer mounted compressor illustrated, the Bristol 271.

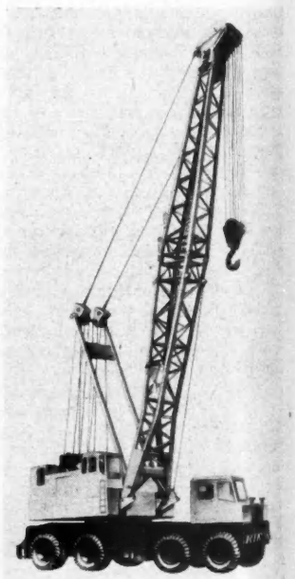
An output of 215 cfm of free air and a working pressure of 100 lb per sq. in are available, both stages of compression being carried out in different parts of each cylinder by a truncated double acting piston. Large cooling surfaces are thus provided on the high pressure cylinders, which are effectively cooled by air blast from the intercooler fan. This design gives more efficiency in less bulk.

The compressor's twin cylinders are mounted on a common crankshaft at 90° and are coupled as an integral unit with the clutch housing and engine. A fully submerged self-priming gear pump provides pressure lubrication to all bearings. A pilot unloader effects complete unloading of all suction valves and the intercooler during idling, and a time lag control enables the engine to regain full running speed before the compressor comes back on load. Low piston speed reduces wear.

The engine is a Fordson 6-cylinder industrial diesel type 590E giving 64 bhp at 1,500 rpm. A Twiflex centrifugal clutch is fitted with inherent vibrational and torsional damping, and is set to engage the compressor after completion of engine starting. The interconnected twin tubular air receivers have a total capacity of 4½ cu. ft and are provided with five ¾ in outlet service valves. An underslung 14 gallon fuel tank is fitted and oil bath type air intake filters are included for engine and compressor. *Bristol Pneumatic Tools Limited, Fishponds, Bristol.*

DIESEL-ELECTRIC TRUCK CRANE

55 tons Capacity



LATEST addition to the Coles range of diesel-electric truck cranes is the Valiant, which has a lifting capacity of 55 tons at 12 ft radius on the standard 50 ft centre strut jib, which is extendable to 140 ft by the insertion of extension pieces. Other jibs up to 240 ft, including a 40 ft fly jib, are available. With the 200 ft jib the capacity is six long tons at 40 ft radius.

Separate diesel engines are used for the crane and the chassis, the former being a 11·3 litre AEC engine and the latter a Rolls-Royce 12·17 litre supercharged diesel. Diesel-electric transmission for hoist, derrick and slew motions is used. All movements are reversible and can be operated simultaneously. The chassis is a heavy duty eight wheeled four-wheel drive carrier with frame fabricated from steel beams and plates. The travel motion includes a fluid drive and an eight-speed forward with two reverse gearbox. *Steels Engineering Products Limited, Crown Works, Sunderland.*

REAR DUMP HAULER

Versatile and Economical

A FURTHER development in the scope of tractor haulage has been made with the Shawnee Poole FD535, which comprises a 32 bhp prime mover articulated with a rear dump hauler.

Designed to work under rugged off-highway conditions as a muck-shifter, the FD 535 has a fast cycle time on the highway and with the flat deck trailer available is well suited also for building contractors' haulage, municipal work and timber extraction.

Capacity is 5 cu. yd and a payload of 6 tons. A turning angle of 110 degrees is obtained by means of a goosenecked coupling which also provides stability on all three planes of movement, ensuring maximum safety for the operator. Mounted underneath and forward of the rear axle centre-line, the coupling allows weight transference from the towed element to both rear and front axles of the prime mover, and maximum traction, efficiency and steering control are thus possible.

Tipping gear comprises twin telescopic hydraulic rams operating from the prime mover hydraulic system at 2,400 lb per sq. in. The body is of heavy duty all-welded steel, with fabricated main frame structure of heavy gauge plate and rolled channel. The main coupling assembly component is of high tensile steel.

The prime mover is a standard industrialized version of the Fordson Dexta, a tractor built for all kinds of operating conditions, and whose operating costs are no higher in the FD 535 combination with its 6 ton payload.

This new unit, smaller than previously introduced haulers of its kind, is likewise claimed to cut the operating costs of more conventional earth haulage equipment by as much as 50 per cent. The FD 535 will feature in the manufacturers' training courses in earth moving. *Shawnee Poole Limited, Falcon House, Woodley, Reading, Berkshire.*

TRACTOR COMPRESSOR UNIT

Air Cooled

IN A NEW combination known as the Roughrider, an air-cooled air compressor is mounted on a tractor and driven from the tractor's power take-off.

The combined unit consists of a Fordson Major tractor carrying a two-cylinder reciprocating compressor, the Atlas Copco VT4, which is capable of a compressed-air delivery of 140 cfm at 100 lb per sq. in. The Roughrider is designed to carry a reliable supply of compressed air almost anywhere, and its output is sufficient for two heavy breakers, one heavy rock drill or a combination of smaller tools.

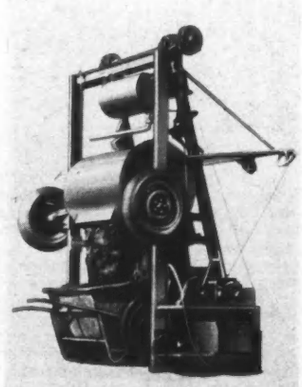
The compressor, with V-opposed cylinders, is intended for high-speed operation, imposing minimum torque variations on the tractor power take-off mechanism. Transmission is through toothed ropes and pulley. An automatic speed-reducer cuts engine speed during no-load periods for maximum fuel economy. Normal compressor speed is 1,440 rpm.

The cylinders are cooled by a fan-induced controlled-air flow. The crankcase is of unit-welded construction and accommodates the cylinders, which are seated in it but insulated from the sump by means of O rings. The annular valves are of Atlas Copco time-tested design with greatly enlarged areas and reduced lift to render them capable of efficient service at high compressor speeds.

Tractor power take-off speed is 720 rpm. The weight of the Roughrider is 6,000 lb and its dimensions are 12 ft 3 in long, 5 ft 5 in high and 5 ft 9 in wide. *Atlas Copco (Great Britain) Limited, Maylands Avenue, Hemel Hempstead, Hertfordshire.*

BATCH CONCRETE MIXER

High Output



THE MACHINE illustrated will produce mixed concrete of consistent quality at very low operating costs.

Power requirements are only 8½ hp and cement consumption is also low due to a new patented mixing technique. Rapid emptying of hopper and mixing drum, fast mixing time and new patented loading device (optional) are features which are conducive to a high output.

A sturdy construction keeps maintenance costs down. The machine is readily transported or towed on its pneumatic tyres, and erection on site is rapid.

Aggregate and cement, accurately weighed, are delivered to a stationary cylindrical mixing drum. Metered water is added as required and the mixing action is effected by rotating paddles of patented design within the drum. The paddles are fitted with renewable manganese steel wearing plates.

Batch capacity of the machine is 7 cu. ft of mixed concrete. Loading with an electric scraper gives an output of up to 710 cu. ft per hour. A complete working cycle can be accomplished easily in 36 sec.

The machine is 11 ft 6 in high in the working position, and occupies a floor space of 5 ft 11 in by 4 ft 3 in. The weight is approximately 32 cwt. *Construction Machinery Limited, Thornes Moor Road, Wakefield, Yorkshire.*

SELF-LOADING DUMPER

5½ cu. yd Body

A SELF loading dumper with a 1 cu. yd bucket and 5½ cu. yd body is now on the market.

The Wakefield SD55 is a four wheel drive machine with the loading shovel working beyond the tail board. The driver sits on a swivel seat with duplicated controls for travel in both directions. This means that there is no turning of the vehicle after loading—it merely reverses and drives away. The shovel loads in the normal way, then is raised to tip in the body.

Power is supplied by a Leyland AU350 diesel engine of 100 hp at 2,200 rpm. Transmission is through a dry plate clutch and constant mesh box with five high and five low ratio gears giving a total of 10 speeds in each direction from 2·13 to 32·6 mph. Drive is on all four wheels and the steering is power assisted. Air brakes are fitted on both front and rear wheels.

Large capacity hydraulic rams are used for the shovel lift arms, bucket movement and dumping. Body tipping is positively controlled through a linkage. The overall length with the bucket down is 21 ft 2 in and with the bucket up, 15 ft 10 in. The overall width is 8 ft; height without cab 7 ft 7 in and with cab 9 ft. The wheel base is 9 ft 3 in. Unladen, the weight of the vehicle is 15,640 lb.

Standard fittings include 24 volt electrical system, Burgess oil-bath air cleaner, hourmeter, mirror, and horn. Optional extras include larger tyres than the 10 by 24 14 ply normally fitted, alternative oil cleaners and open canopy or enclosed cab. *Construction Machinery Limited, Thomas Moor Road, Wakefield, Yorkshire.*

TRACTOR SHOVEL

Centre Point Steering

CENTRE POINT steering is one of the features of the Mastiff series II tractor shovel.

This arrangement of central articulation eliminates hub universal joints and allows the wheels to keep their fixed positions relative to the chassis. Turns can be made with the vehicle stationary so that loads can be exactly spotted for discharge. A right angle turn can be made in a gangway only 15 ft wide.

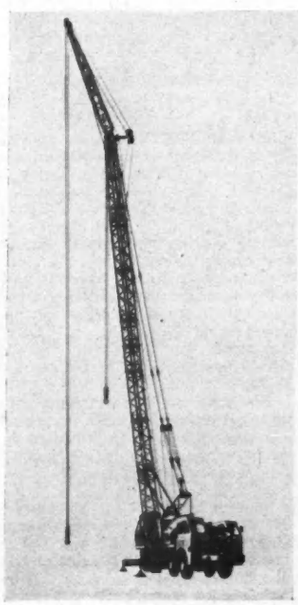
The series II machine has capacity of 5,000 lb with a standard 1¾ cu. yd bucket (S.A.E. rating), which is 4 in wider than the wheels. Bucket breakout force is 25,000 lb and maximum angle for crowd is 60° at 36 in from ground level or 48° at ground level. Maximum discharge height under the tipped bucket is 102 in. The maximum outreach is 75 in.

Power is supplied by a Ford 6 cylinder diesel engine developing 95 hp at 2,250 rpm. Transmission is through Brockhouse torque convertor and epicyclic box giving four forward speeds from 4 to 20 mph, and two reverse. Disc hydraulic brakes operate on all four wheels by acting on the high speed intermediate shaft. A single hydraulic pump supplies both power and steering.

The machine is fitted with all-weather cab with windscreen-wiper as standard. The tropical radiator has a high velocity fan. The rear hinging bonnet gives easy access to the engine and auxiliaries. There is a separate cooler for the torque convertor oil. *Matbro Limited, Matbro Works, Horley, Surrey.*

MOBILE CRANE

27 tons at 12 ft Radius



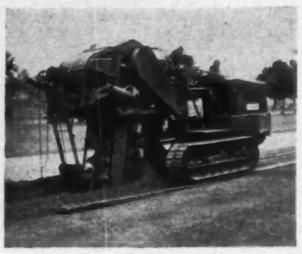
A NEW truck-mounted crane will handle loads up to 60,000 lb at a radius of 12 ft and up to 16 ft per minute.

The superstructure is powered by a 75 hp Dorman diesel engine with three lever operation of the lifting, slewing, rapid boom hoisting, and power lowering under load. Large capacity foot brakes control quick load lowering under gravity and with power lowering permit very precise placing.

Designed for current building trends, the 30 to 100 ft lattice boom will take 20 to 30 ft fly jibs to a total length of 130 ft to enable a maximum load of 10,000 lb to be lifted at 37 ft radius with a jib head pin height of 132 ft. Pendant boom suspension is provided to facilitate changes in boom length and provision is also made for lifting over boom point and jib point simultaneously if required. A Foden FC20 eight wheel chassis provides the mobile platform for the crane, driven by a 150 hp Gardner engine. *Priestman Brothers Limited, Hedon Road, Hull.*

DITCHER

For Confined Spaces



DITCHES up to 7 ft deep can be cut with the Barber Greene model 784 vertical boom machine illustrated.

Operating features of the machine are that it will dig straight down and leave no ramp, and can "jump" pipes or other obstacles. There are three widths of cut, 19 in, 21 in, and 24 in, and digging speeds using the Hydra-crowd hydraulic system are infinitely variable in two forward ranges from zero to 15 or to 31 ft per minute and in reverse to 15 ft per minute. A relief valve prevents overload of the crawler drive when digging.

The standard model is powered by a 105 hp petrol engine driving through a clutch and three-speed and reverse gearbox. Internal hydraulic brakes are fitted on the crawler drive differential and are also used for steering. A vane type hydraulic pump is used for the conveyor drive, and others for the the hoist and crowd control; two 6 in double acting hydraulic rams operate the wheel hoist. There are three bucket line speeds of 89·4, 160·5 and 274·5 ft per minute, and the three travel speeds are 1·01, 1·80 and 3·08 mph forward and 0·53 mph reverse.

The buckets are set at 6 in pitch and feed to an 8 ft long conveyor. Belt width is 18 in. Direction of discharge is reversible and a hydraulic motor drives each end of the belt. The speed is variable up to 630 ft per minute. The machine has an overall width of 8 ft (7 ft across the crawlers) and length of 23 ft. Operating height is 8 ft 7 in. The normal boom clearance measured above the pavement is 15 in. *Jack Olding and Company Limited, Hatfield, Hertfordshire.*

EXCAVATOR

3 cu. yd Capacity

NOW being built in this country, and available in several forms, is the Koering 1205 excavator.

The boom has been designed to conform with British Standard specifications and the basic lattice boom of 60 ft can be extended to a maximum length of 150 ft. Jib booms up to 30 ft are available with main booms up to 140 ft. The maximum lifting capacity of the machine as a crane is 55 tons, based on 66·2 per cent of the tipping load. A special long range shovel front end attachment will shortly be available with a 50 ft shovel boom, 36 ft dipper stick, rope crowd mechanism and 2½ cu. yd bucket, and a digging reach of over 65 ft.

The machine is fitted with automatic air release traction brakes which are always "on" except when the traction power is applied by the operator. The positive mechanical drive clutches require a pull of 12 lb to engage the main drum and it is claimed that the feel of the load is maintained throughout the engagement. Torque convertor drive is fitted as standard. The crawler unit is a self-cleaning design with wide smooth-faced shoes to increase stability and reduce bearing pressures to a minimum. Crawler shoes up to 42 in wide and belts up to 19 ft 3 in long are available.

The heavy duty rock shovel attachment that is available is equipped with twin outside dipper sticks and a full positive chain crowd. Boom foot shock absorbers take the shock loading out of rock excavation and absorb the twisting and bending strains of heavy digging. The face shovel version is illustrated. For dragline work a 3½ cu. yd bucket is fitted. *NCK-Rapier Limited, 32 Victoria Street, London SW1.*

DIESEL ROAD ROLLER

Hydrostatic Transmission

A THREE-WHEEL diesel road roller, the Road-Marshall Highwayman Mark 2 incorporates hydrostatic transmission and an unusual system of ballasting.

Power is transmitted to the rear rolls through a tilting head type piston pump and fixed displacement motor. This system provides infinitely variable road speeds from 0 to 5 mph forward and reverse, and eliminates clutch and change speed gearbox. The roller weight can be varied from 9 to 16 tons and ten separate 10 cwt cast iron weights are placed in the centre portion of the main frame. Both front and rear rolls may be filled with water or sand as ballast.

A new type of 2-tine hydraulic scarifier is fitted, with variable depth control operated either from the side of the roller or from the driver's seat.

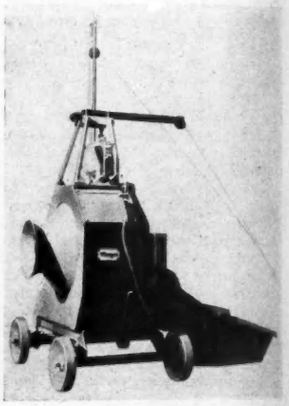
Either water or air cooled power units are available. Power operated hydraulic steering gives control over 80° steering lock. A servo-operated lockable hand-brake acts on the hind rolls. All braking is normally applied automatically through the hydrostatic system.

Equipment for water spraying consists of an 83 gallon tank situated in the main frame below the ballast compartment, and spray pipes to front and rear rolls.

The main frame is of all steel welded construction. The driver's cab is totally enclosed and toughened glass windows are fitted, with an electric wiper on the front window and a hand wiper at the rear. *Marshall Sons and Company Limited, Gainsborough, Lincolnshire.*

REVERSING DRUM MIXER

Non-Tilt



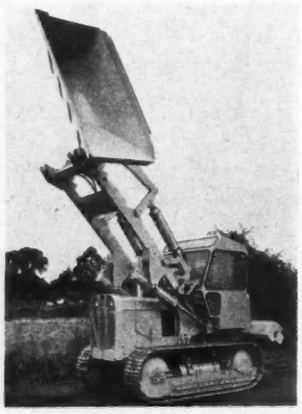
NEW to the range of mixers is the 10NT/R model shown in the illustration.

This is a machine of 14/10 capacity, built to British Standard specifications, of the reversing drum non-tilt type. Many features of the larger machines in the company's range are included. The standard model has hydraulic hopper operation coupled with accurate water dispensing, accurate weighing and efficient drag feeding. The design differs from that of earlier models in two ways intended to improve the efficiency.

The drag-feeder is of the normal type controlled electrically by push button from the scraper bucket, but it has a fixed jib. The length of the jib is such that the overall width of the machine when arranged for transport is 7ft 6 in without having to carry out any dismantling. Ample clearance for the hopper lift is provided. The wheels are arranged to give a side discharge machine while yet keeping the overall size to very compact dimensions. All controls are grouped at the end remote from the power unit, at a position where the operator has a good view of both hopper and drum discharges. The machine is said to be rapid in operation and to have been extensively tested under site conditions. *Winget Limited, Rochester, Kent.*

CRAWLER SHOVEL

Side Tip Bucket



THE CASE 1000 D industrial tractor shovel incorporates easily-operated control over motion and steering in a rugged digging-loading machine.

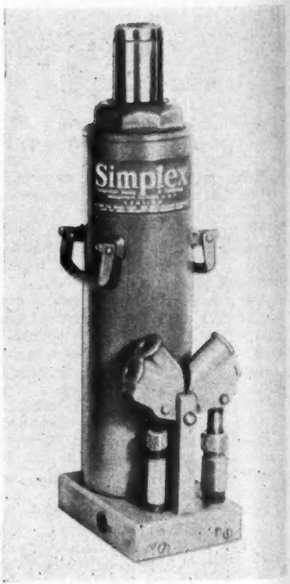
Counter-rotating Terramatic drive provides power-shifting and finger-touch steering when in motion, with independent control of each track. A torque converter automatically increases push-pull power as needed. Hydraulic controls reduce operator fatigue and promote output per shift. All tractor movements are controlled by foot throttle, hydraulic foot brakes and four hydraulic levers.

The Boughton hydraulically-operated side-tipping bucket, which is quickly interchangeable with the standard forward-tipping bucket, is of 1½ cu. yd capacity and facilitates operation in confined spaces.

Power is provided by a 100 hp 4-cylinder diesel engine. A 4-speed selector gives 0 to 6 mph forward and 0 to 7·2 mph reverse. The hydraulic powered disc brakes are controlled by two foot pedals which neutralize the power drive. A hand-operated parking brake is standard. Hydraulic track adjusters and automatic roller lubrication make for easier maintenance, and torsion suspension increases traction and effective steering control. *J. I. Case Company Limited, Mill Road, West Drayton, Middlesex.*

HYDRAULIC JACK

Long Lift



A NEW hydraulic jack in the Simplex range, the Model No. 50H26, has a 50 ton capacity and the unusually high lift of 20 in.

As the illustration shows, this jack is fitted with double lever socket and high and low speed pumps which can be operated singly or in unison. The model has a low height of 26 in.

Ease of operation with engineered safety and versatility are factors which make the jack suitable for general application as well as for specialized jobs. It is tested to 50 per cent over rated capacity, and may be operated in either the vertical or the horizontal position with equal efficiency and safety.

The manufacturers claim that a minimum of maintenance is required as a result of precision methods of construction.

Spring-controlled ball valves are incorporated in the design, and also Neoprene seals and a solid steel base. *The Equipment and Engineering Company, Limited, 2 and 3 Norfolk Street, London, WC2.*

Take a Tomato when Touring Abroad

Cool fruit round the feed pipe might prevent petrol vaporization in hot weather but some more realistic technical precautions for motorists who plan to take their cars abroad this summer are recommended by the touring department of the Automobile Association.

By R. S. Campbell

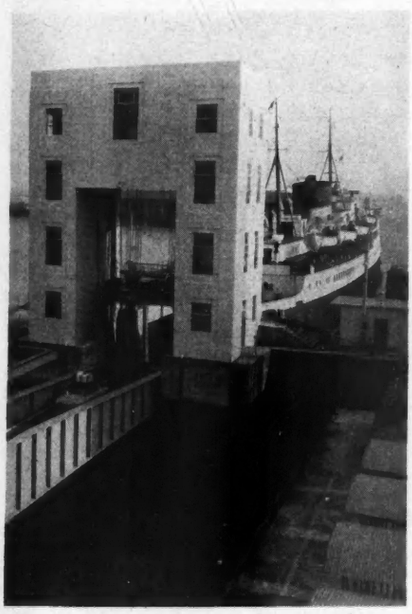
Automobile Association

WHO ever heard of a tomato being taken on a Continental tour? The Automobile Association has: one of the 170,000 AA members who spent a holiday abroad last year carried one with him whenever the temperature was high as a remedy against petrol vapourization cutting his car engine dead. "The tomato, placed round the petrol feed pipe, was always the perfect cure," he said.

AA engineers would hardly recommend it as the textbook cure for vapourisation, but when it comes to taking a car abroad for a trip covering perhaps 2,000 miles in a fortnight they would certainly advise that the vehicle be given a thorough check before setting out. After all, the last thing a driver on tour wants when in search of relaxation is anxiety about the reliability of his means of transport.

But what to do and where to begin?

First, if you don't feel competent to do your own servicing, have it done professionally. Those who are going to tackle the job themselves should start off by thoroughly greasing all



Drive-on car ferry at Dover's eastern dock. It has been in use since June 1953.

nipples and, where approved, spraying the road springs with penetrating oil.

After the greasing, drain the gearbox, sump and rear axle, and refill with the oil recommended in the car manual. The brake reservoir and the clutch reservoir, also the shock absorbers, should have attention and, if topping up is necessary, make sure that the right type of fluid is used.

If you have any doubts whatever about the brakes or steering, don't trust to luck—have the joints and the brake linings looked at by an expert eye.

Tyres are an extremely important part of any car's equipment, and worn or patched tyres should never be trusted to last the journey. If you *must* go on tour with worn tyres, put the two best ones on the front and also make sure that the spare is serviceable. Always stick rigidly to the pressures recommended by the makers.

Next on the list is the car's "nervous system"—the electrical equipment. See that the battery is fully charged and correctly topped up with distilled water. Charging and checking done, protect the terminals with petroleum jelly in order to stop corrosion and tighten them down.

Clean the distributor head both inside and out, see that the carbon pick-up brush moves freely and check the gap between the contact breaker points. If the plugs have done more than 10,000 miles, replace them. This precaution not only avoids possible trouble, but gives a better performance, saves fuel and makes starting easier.

Then there are the lights. Make sure that all bulbs are in working order and not discoloured and that the headlamps are adjusted to avoid dazzle. Yellow headlamps are not compulsory for visitors to France but if you are doing any amount of night driving it would be as well to fit yellow bulbs which have a vertical dip. Alternatively, install right-hand dip lenses and bulbs.

Dirt is the big enemy of the fuel system, and just a small speck in the carburettor can cause endless trouble. If the car is old, drain and flush out the fuel tank and if the petrol pump has been in service for some time, a new or reconditioned unit should be considered.

ESSENTIAL SPARES

What spares, if any, should one take? A set of spare parts can be obtained from most main agents (they are returnable if not used but a handling charge will be made), but in any case you would be wise to take a spare set of fuses, lamp bulbs, at least two sparking plugs of the right type, a spare fan belt, a wiper blade, a cylinder head gasket and certainly a spare inner tube (which in an emergency can be fitted to a tubeless tyre).

If it is a case of a really serious breakdown and no spare part can be obtained locally, AA members can call on the Association's spare-parts service. Under this scheme the part required will be flown out—usually within 48 hours and in many cases within 24 hours—so that the journey can be continued. The Association pays the first £5 of all freight charges and spare parts that are sent to members under this service.

PETROL PREVIEW

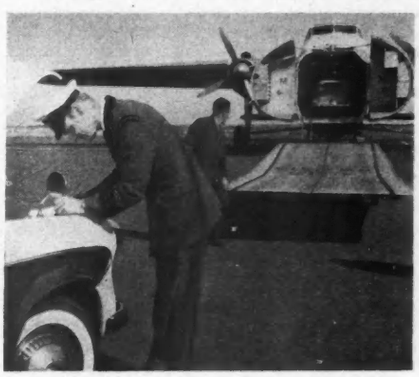
Petrol on the Continent is generally of good quality. Two grades are usually available and in most cases they compare favourably, as far as anti-knock value is concerned, with the regular and premium grades sold at home. Be wise, however, and always buy the better grade where there is a choice.

Top up to the brim at every opportunity because in some of the more remote areas filling stations may be a little difficult to find. Petrol at a special tourist rate is available in France, Italy, Czechoslovakia, Yugoslavia, East Germany, Rumania, Bulgaria, Russia, Hungary and Poland. To give you an idea of the saving, super grade petrol in France costs 6*s* 10*d* a gallon (ordinary grade, 6*s* 5*d*), but to the holiday maker from Britain it works out at approximately 5*s* 5*d* super and 5*s* 2*d* ordinary. There is an even greater saving in Czechoslovakia where petrol is 10*s* a gallon ordinary—there is only the one grade. To the tourist it comes out of the pump at 4*s* 6*d* a gallon.

One of the changes in the pattern of foreign touring which has taken place over the past few years is the growing popularity of caravanning abroad. The rules of proper servicing apply no less to a caravan than to a car; it would obviously be foolish to pay particular attention to one and ignore the other.

CARAVAN CARE

It is essential, when travelling in hilly or mountainous districts, to be satisfied that the car has ample power to deal with the total load which is being both carried and towed, and bottom gear must be low enough to ensure



The AA chief port officer at Lydd checking engine and chassis number of a tourist's car before it is loaded on to a Silver City air ferry for the Continent.

that the steepest hill can be tackled comfortably. Towing ability does, of course, vary with engine efficiency and gear ratios and a car with a four-speed gearbox may, for example, have the advantage over one with a three-speed box, especially in difficult country.

The caravan should never be heavier than the car. As a guide, cars with engines of under 1,200 cc should not be expected to tow a caravan of over 10 cwt laden weight. With cars in the 1,200 cc to 1,500 cc range, caravans of up to 12 cwt laden may be used. A 1,600 cc to 1,800 cc car can tow a caravan of about 17 to 18 cwt, and one of 2,000 cc is needed for a caravan weighing a ton.

The towing bracket on the car and the tow-bar coupling must be strong and securely fixed and capable of dealing with the heavy loads imposed. The load in the caravan should be distributed to give balance as abnormal upward or downward thrust on the draw-bar can adversely affect steering, wheel grip and brake efficiency.

BRAKING IMPORTANCE

The importance of brakes cannot be over-emphasised because a car, when towing, has less braking ability than usual. The automatic over-run brakes on the caravan are less effective, weight for weight, than the car brakes, and some of the braking effort for the caravan must be supplied by the car. Greater stopping distances should therefore be allowed, and the lower gears should be engaged downhill in order to make full use of the retarding effect of the engine.

And don't forget the tomato—although a wet cloth round the petrol pump to keep it cool is a much more likely way to prevent vapourisation!

Prolific Progression

NUCLEAR research is expanding rather than contracting in spite of the apparent recess in the nuclear industry. It illustrates the importance that governments are laying on the introduction of this further source of power and the belief that an economical balance will eventually be reached with the conventional sources. Although the present stations are being developed to be as efficient as possible, it is realised that the power reactor design of the future may have little connection with the present series.

Diphenyl Reactor

A reactor has been designed by the Marquardt Corporation of the United States that is claimed to have competitive costs with the conventional steam-electric plants in the 5 to 20 MW(e) range. The reactor has a direct cycle and uses diphenyl as the coolant. The properties of diphenyl allow saturated diphenyl vapour to expand in the turbine without condensing, thus eliminating moisture separation and reheat. The low vapour pressure and non-corrosive nature of diphenyl allow a much simpler turbine design and the use of low alloy steel, contributing to economic reductions. The moderating and fuel canning material is graphite.

Novel Pressure Suppression Containment

Construction is to begin on a 50 to 60 MW[e] direct-cycle natural internal-circulation boiling-water reactor to be built at the Pacific Gas and Electric Company's plant at Humbolt Bay. The reactor is to serve as the third unit at the plant, the other two units being conventional generating plants. A novel scheme of pressure suppression containment is proposed, consisting of a pressure-tight carbon-steel vessel, called the dry well, which will enclose the reactor vessel and associated piping up to the first valve in each line and also the control-rod drives. The dry well will be surrounded by another pressure container constructed of reinforced concrete and lined with thin steel plate. This container, known as the suppression chamber, will be partially filled with water forming a suppression pool. The dry well and suppression pool are designed to function in the event of any failure occurring to reactor pressure vessel fittings or primary system piping up to the first valve. Steam or saturated water from the break would flash to steam and fill the dry well, from which it would be vented to the suppression pool where it would condense. The containment and reactor systems will be located underground in a structure of reinforced concrete.

Further Experimental Resources

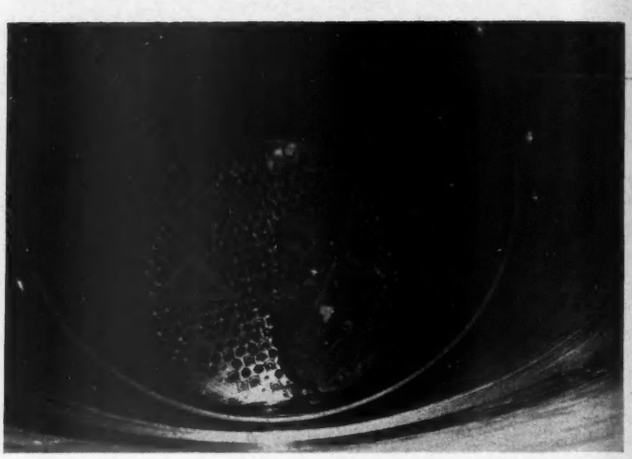
In order to conduct the necessary experiments, the Babcock and Wilcox Company have been using the former Nuclear Merchant Ship Reactor using concentrations of heavy water in the lower ranges—between 50 per cent and 80 per cent, depending on the two types of fuel elements used. Similarly the company is now asking to modify the Lynchburg Source Reactor so that it can perform experiments in the higher ranges above 50 per cent and 80 per cent. The fuels to be used were previously used in the Nuclear Merchant Ship Reactor (NMSR) and the Thorium Uranium Physics Experiment (TUPE). The exponential experiments will be performed with heavy water concentrations of 80 per cent and higher for the NMSR 4 per cent enriched uranium fuel and 50 per cent and higher for the TUPE highly enriched uranium thorium oxide fuel.

Test for Pluto

The first power test for the Tory II A-1 reactor is scheduled for May 12, 1961, at the Nevada test site. It is a direct-cycle air-cooled reactor fuelled with highly enriched uranium homogeneously mixed with beryllium oxide which went critical for the first time last December. It has been designed at the Livermore laboratory of the University of California and is being developed as part of the joint United States Atomic Energy Commission—United States Air Force project Pluto programme to demonstrate the feasibility of using nuclear power for ramjet propulsion: it is unrelated to the terminated aircraft nuclear programme. This test is the first of a series planned to operate the reactor at progressively higher power and temperature levels. The reactor is mounted to a railroad car and coupled to a concrete field test building for power testing. The tests are conducted by remote control from a distance of about two miles although no appreciable radioactivity release is anticipated.

Successor to DCX-1

After three years operation the DCX-1 is to have a successor, the DCX-2, the new facility is expected to be in operation by the autumn; the rate of ion injection will be increased to 600,000 eV, and it is hoped to reach a temperature of 3×10^6 ° C, which is comparable to the three stage magnetic mirror device in use at the Livermore Laboratory of the University of California.



The 50 ton underground stainless steel vessel for the Hallam Nuclear Power Facility. Supports for the moderator cans and fuel elements are arranged in a honeycomb fashion in the bottom grid plate.

Agreement Signed between USSR and UKAEA

A five year agreement for collaboration on the peaceful uses of atomic energy has been signed between the USSR State Committee of the Council of Ministers for the Utilisation of Atomic Energy and the United Kingdom Atomic Energy Authority, during the recent visit of the Russian delegation headed by Professor V. S. Emelyanov.

The agreement states that conferences and visits to facilities in the respective countries will be organized, and representatives of the two bodies will meet periodically to decide on the subjects and methods of collaboration to be reviewed. There will be reciprocal exchanges of unclassified reports concerned with the peaceful uses of atomic energy, and it is hoped to that some assistance will be derived from the exchanging of radioisotopes and apparatus used in atomic energy.

Reactor Notes

Trilateral Agreement: The United States, Norway and the International Atomic Energy Agency have signed a contract for the 3 per cent enriched uranium 235 for the fuel in the zero power critical assembly NORA, which Norway is making available for an Agency sponsored cooperative programme. The fuel core was originally used in development work for the nuclear ship NS Savannah and contains approximately 42·4 kg of uranium 235. The other two core loadings are being provided by Norway —one consisting of natural uranium and the other enriched to 1·7 per cent.

Indonesia: The United States Government has awarded $350,000 towards the 100 kW Triga Mark II training and research reactor which is to be installed at the Institute of Technology at Bandung. Indonesia is the twenty-third country to receive a $350,000 grant from the United States Government.

Competition in Rocket Development: Seven firms have responded to invitations from the USAEC, National Aeronautics and Space Administration Nuclear Propulsion offer for the proposals on research and development of a nuclear rocket engine. The first phase in the programme will include assistance to Los Alamos Scientific Laboratory in the Kiwi-B test programme, and to conduct a preliminary design of the flight programme.

New Lightweight Generator: A completely portable nuclear auxiliary power device which weighs considerably less than 40 lb using direct conversion has been designed and constructed by the Westinghouse New Products Laboratory for the Air Force Special Weapons Centre. Curium 242 is used as the heat source, and will produce about 150 watts of electricity. There are 144 small semi-conductive heat elements heated-by the curium to about 1,000° F.

Another Italian Project: Mitchell Engineering have been awarded the contract for the design of a nuclear 110 MW(t) boiling water reactor suitable for integration with the existing steam electrical facilities at Lardarelle in Tuscany. The American Machine and Foundry Company are participating in the project.

Heavy Water Project Abandoned: Due to technical and economic uncertainties in the development of the beryllium clad fuel elements the United States Atomic Energy Commission is terminating the cooperative project covering a gas cooled heavy water moderated power reactor. The 50 MW(e) plant would have been designed as a prototype for a large central station reactor capable of being fuelled with natural uranium. The interested companies were the East Central Nuclear Group and the Florida West Coast Nuclear Group.

Cornell University: The USAEC will provide $94,000 for fuel fabrication costs of the Zero Power Reactor at Cornell, and will also lend 37·2 kg of uranium 235 and a plutonium-beryllium source. The 10W reactor will have a water moderator and enriched uranium fuel in the form of oxide pellets inserted in aluminium tubes, which can be arranged in various lattices by means of moveable plates. A TRIGA reactor is also under construction in the university laboratory for which a grant of $150,000 was made by the Commission in June 1958.

Companies

Cunard Steamship in Troubled Waters

It is a reasonable calculation from the figures for the CUNARD STEAMSHIP Company's past year that if there had been no unofficial strike of seamen and no tally clerk's strike in the London docks then the forecast of Sir John Brocklebank, the chairman, a year ago, that the year would show a modest improvement over 1959, would have been fulfilled.

As it was, the year ended with the operating surplus down by £498,000, the two strikes having reduced the gross operating profit of the group by not far short of a million pounds. In directly accountable loss the tally clerks' strike cost Cunard £261,000, and the seamen's strike, at the height of the passenger season, another £398,000. These figures account for only part of the damage since many passengers transferred rather than face doubts about sailings. Until the outbreak of the July stoppage there had been an encouraging increase in profits. After early July, bookings in both directions fell off rapidly and Cunard estimate that the loss of passengers to other ships and airlines cost an additional £250,000 loss of profits. There was also some loss of cargo for the same reasons.

Surveying recent wage movements, against which shipping operators have no such cushion as a home market, the Cunard chairman reports that the wage costs of one of the lines' large units were raised by 14 per cent last August. If the wage claim now being negotiated were granted in full the crew costs of the larger units would go up by about 48 per cent in less than a year.

"The goose that lays the golden eggs," says Sir John Brocklebank, "is by no means dead, but unless we have a period ahead of reasonable stability her actuarial expectation of life must inevitably be shortened."

Profit to Loss

CUNARD EAGLE AIRWAYS, who have figured in the recent debates on the proposed Government loan to Cunard for a replacement to the Queen Mary, declined from a £100,000 profit in 1959 to a loss of an equal amount last year.

The causes of the trouble throw a valuable light on the problems of running independent airlines. The company's plans for 1960 were made in advance of knowledge of the Civil Aviation (Licensing) Act and it was thought wise to make changes in the programme which caused short term losses. Unforeseen competition came up on the Miami-Nassau shuttle service and negotiations to improve the profitability of that service are going on. And lastly, the whole of the costs of moving the Eagle headquarters from Blackbushe to London Airport are included in the accounts, and are, of course, non-recurring.

The outcome of the company's application for a passenger licence across the North Atlantic is justly described as of "tremendous importance."

On the controversial Queen Mary replacement issue, the Cunard chairman reports that they expect to receive the tenders from the six yards able to build the proposed ship at the end of next month. In agreement with the Government it has been decided, for administrative convenience, that the Q-3 shall be operated by a one-ship company. For a number of reasons the CUNARD WHITE STAR Company is convenient for the job.

From Motor Trade to Electronic Research

The SIMMS MOTOR AND ELECTRONIC Corporation, of East Finchley, North London, with capital assets now approaching £6 million, last year reached the record group profit before tax of £1,408,147, an increase of £370,457 over the year before. These outstanding results were obtained despite considerable narrowing of profit margins. Greater turnover, at home and for export, coupled with more efficiency in production, provided a measure of relief from the pressure on costs of higher material awards and rising labour costs.

All the member companies contributed to the overall group results. Diversification plans have worked out well and while all the sectors of the group are expanding, particular attention is being devoted to the electronics field, a move which helps to reduce even further the company's former complete dependence on the motor industry.

Mr. G. E. Liardet, the Simms chairman and managing director, suggests in his annual report that the United Kingdom's share in world markets has decreased largely because British prices are becoming too high. Vast expenditure on increased mechanisation has not increased national productivity in the same proportion and we are lagging seriously behind our main competitor nations. Over the past decade the prices of imported manufactured goods fell by about 5 per cent, while British export prices had risen over the same number of years by as much as 15 per cent.

Simms Motor and Electronics have fifteen principal operating companies and a number of others. Looking round them, Mr. Liardet pointed out the contract for complete fuel injection equipment for their diesel engines placed with SIMMS MOTOR UNITS by the United States FORD MOTOR Company.

USA and Puerto Rico

At the close of last year the same operating company joined a sales and manufacturing agreement with the BENDIX Corporation, by which Bendix acquired sole selling, servicing and production rights in Simms diesel fuel injection equipment in the United States and in Puerto Rico, and non-exclusive selling and servicing rights in Canada, Mexico and Brazil.

DAWE INSTRUMENTS Limited, a company acquired in the past year, has a lively export record, including a sizeable volume of trade with the Soviet Union. Principal products of the company are stroboscopes, sound and vibration measuring equipment, ultrasonic gauges and cleaning apparatus and the general instruments of the electronics and communications industry.

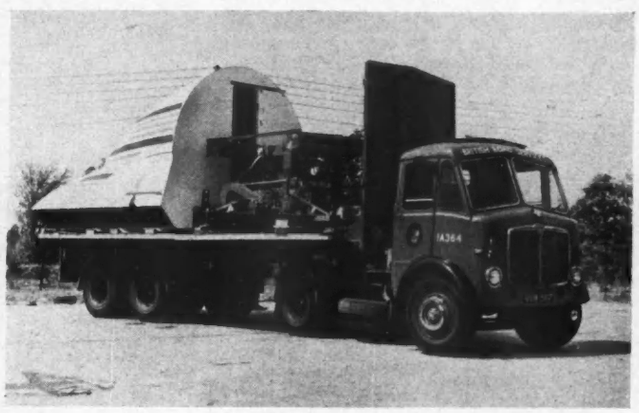
In a new building on the site of the electronics research laboratory at Park Royal, the appropriate staff of Dawe Instruments, and CAWKELL RESEARCH AND ELECTRONICS, another of the Simms companies, will be able to work in close touch with the engineers and scientists of another group company's laboratory (NSF).

The Atomic Energy Authority have placed a number of instrumentation problems with Cawkell Research. The company have this year gained from Harwell an important contract for which there are hopes of interesting commercial applications.

Flight Simulator by Road to Rome

Pilots of the ALITALIA Air Line who are to fly Caravelle jet aircraft are to train on a flight simulator built at the Crawley, Sussex, factory of REDIFON. The simulator is being assembled at the Fiumicine Airport, near Rome.

BRITISH ROAD SERVICES carried the



20 ton simulator door to door without transhipment on three BRS trailers. The Channel crossing was made on the roll on-roll off commercial vehicle ferry service sailing between Tilbury and Antwerp.

The fuselage carrying trailer (inset), which also moved some of the mechanism, had a load 24 ft long, 11 ft 6 in wide and 14 ft 2 in high. Its route ran through Reims, Dijon, Lyons, Avignon, Nice, and crossed the border into Italy on the Mediterranean coast road. The two trailers carrying less bulky components reached Rome through the Brenner Pass. All three trailers had a representative of the manufacturers aboard.

Detours to avoid small bridges were inevitable for the largest load. It was also fitted with a 12 V lighting system around the load to comply with the requirements of the traffic authorities through whose districts the load was moved.

ICI and the European Community

While a definite decision is awaited at Government level on the future association of the United Kingdom with the European Common Market, it is more immediately significant to see what steps are being taken by individual companies in British industry.

Mr. S. P. Chambers, chairman of IMPERIAL CHEMICAL INDUSTRIES, deals with this in his recent annual statement. ICI, after long examination, decided that it would be good long term planning to become established as substantial chemicals manufacturers inside the European Economic Community. For a location well placed for manufacturing facilities, including raw materials and for access to markets, Holland appeared to be an excellent choice.

Accordingly, an option on a lease from the Rotterdam port authorities was taken, with the intention of developing there over a number of years ahead. Although plans are not yet cut and dried it is expected that there will ultimately be a group of integrated chemical plants of a size comparable to the great Wilton chemical "town" and the installations now under construction on the banks of the Severn.

ICI have concluded that manufacture on this site will be "sound and profitable" whether or not the United Kingdom becomes more closely associated with the European Economic Community. Although it is now likely that the company may in the future be manufacturing in the European Common Market in places other than Rotterdam, it is not anticipated that this will reduce sales from the United Kingdom factories, which are to go on expanding and developing as in the past.

On last month's budget proposals, Mr. Chambers recalled that back in the days of the Labour Government the campaigners against the imposition of profits tax were assisted by Mr. Selwyn Lloyd. Alas, since he arrived in office as Chancellor of the Exchequer, Mr. Lloyd has disappointed his former comrades by putting profits tax up to 15 per cent, thus making British company taxation 53·75 per cent, higher than that in the United States. It is also instructive to listen to Mr. Chambers recalling that this level is above that of 1948, which Mr. Lloyd called fantastic and liable to cause the lingering death of private enterprise in Britain.

An Irresponsible Tax

The other industrially damaging budget proposal Mr. Chambers described as placing a heavy tax on production costs. This is the fuel oil tax, which amounts to £2 a ton, or 40 per cent of the fob price of fuel oil. Of this tax less than 10 per cent is to fall on the private consumer, the rest will be borne by industry and the oil burning generating stations.

This increase to its costs is seen by the ICI chairman as a serious blow to the competitive power of British industry.

"Ministerial statements about the need for exports and reducing costs sound rather insincere when the Government's own deliberate action adds substantially to manufacturing costs."

Sprayed Rubber Latex Seals in Mining

This inexpensive and tough rubber coating can be sprayed on to virtually any surface so as to seal air from underground fires and heatings.

A SAFETY aid for Britain's miners—a tough non-inflammable "skin" which can be sprayed on to underground stoppings to prevent air feeding heatings, or harmful fumes reaching other parts of a pit—was demonstrated to delegates to the Mines Rescue Superintendents' Conference on 11 May.

The sealing fluid is a synthetic rubber latex spray and is the result of three years' research and practical experiments by the West Midlands Division of the NCB and the Dunlop Chemical Products Division. It has already been used successfully on several serious heatings, at least one of which threatened to close a Warwickshire colliery.

When this material is applied by spray, the water content is lost by absorption and evaporation so that the latex cures into a highly tenacious rubber film. It can easily be made $\frac{1}{8}$ or $\frac{1}{16}$ in thick, which is what Dunlop recommend. In underground colliery tests, figures produced by Area Laboratories have shown that the coating can be applied for a cost (including materials and labour) between a few pence per sq. ft on brickwork and about 2*s* a sq. ft on a shale pack.

Heatings occur in this way. When a seam is opened up, the adjoining strata and unworked areas of coal tend to split as settlement takes place in the areas from which the coal has been extracted. Air percolates into the fissures and can cause a form of spontaneous combustion, generally known as heating. Speed is essential in dealing with a heating as soon as it is detected.

The routine method of treatment is to cut off the air supply and prevent noxious fumes given off by the heating from reaching other parts of the pit by sealing off the affected area. Without an air supply, combustion gradually dies out. A common method of sealing is to erect a barrier of sandbags, and to plug crevices in the barrier and the surrounding ground with sand or clay. The sandbag barrier is normally the first line of defence and when a more permanent and effective seal is needed a brick wall is erected.

Neither method, however, provides a complete seal against air reaching the heating or fumes escaping from it. There are still small crevices between the seal and its surroundings, and in the adjoining coal and stone. Various methods, such as filling in with stone dust, and pumping in a cement mix under pressure, have been used to provide the final sealant, but none has had complete success.

The first line of defence against an impending heating—the sandbag wall. However, even these are slightly porous and have small apertures in them.

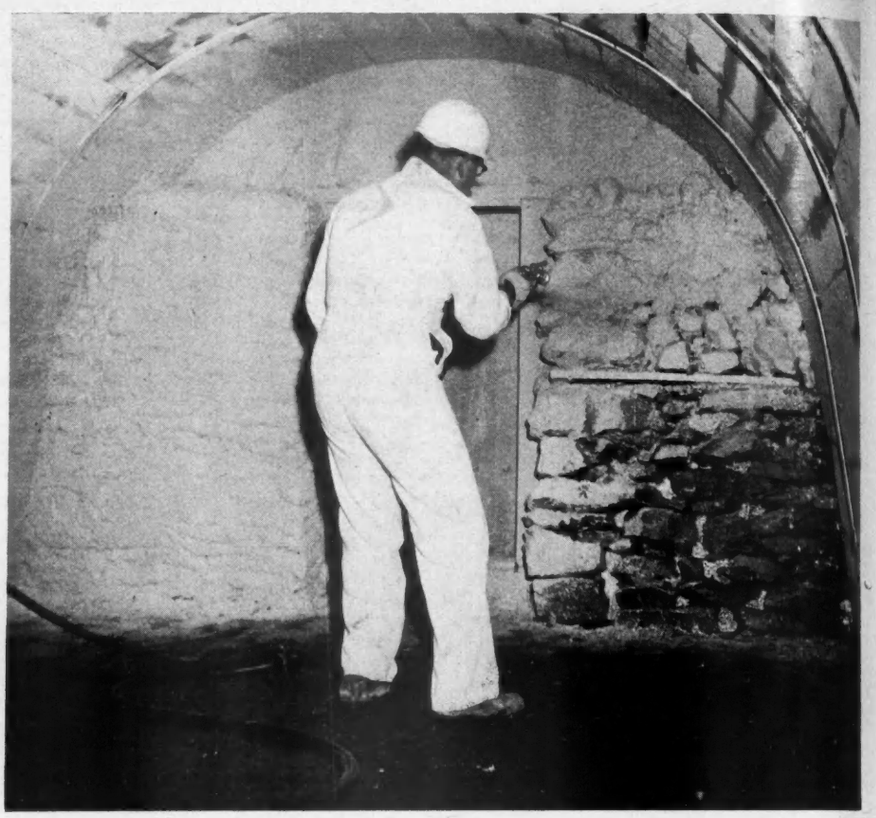
The idea of using some form of self-adhering outer coating as the final sealant, similar to the "cocooning" process for equipment preservation, originated in the Warwickshire area of the West Midlands division. The help of Dunlop was sought in developing a suitable material and they found the answer in the form of a chloroprene latex—an emulsion of synthetic rubber in water.

The following descriptive text is taken from the address by Mr. R. R. Stapleton, development manager for latex at Dunlop, in addressing the Mines Rescue Superintendents' Conference.

"We have a material which by its very nature is non-toxic and non-inflammable and can safely be stored for several months if necessary until it is needed. It can then be applied rapidly and simply by emptying it from the containers in which it comes directly into a 10 gallon pressure pot, and then pulling the trigger of a spray gun to apply it at the rate of 2 or 3 gallons a minute. This means that an 80 sq. ft stopping can be sealed in about 10 minutes.

"The coating adheres so well that a shale pack or a sandbag wall can be pulled to pieces if you attempt to remove the dried sealant—which is so strong that it has a tensile strength of over half a ton (average value, 1,266 lb) per sq. in. Films do darken on continued exposure to light but show no signs of deterioration eighteen months after application. But, most important of all, films of the sealant are almost completely impervious to the passage of air. Determinations have been made using the high pressure apparatus for testing tyre inner tubes and the amount of air which can be forced through a perfect film is so small that, if it were part of a stopping $\frac{1}{8}$ in thick under a pressure of 3 in water gauge, only 1 cu. ft of air per min would pass through a stopping 26 million sq. ft in area."

On how to use the sealant he went on to say. "If sealing is needed under emergency conditions you will usually find that there is a sandbag wall already built and we think that this is probably the best surface of all for sealing. If there are any obvious holes it it, first plug these with hessian, paper, a handful of sand or anything else convenient. The idea is always to make a reasonably continuous surface.



Spraying the latex developed in the first instance for controlling air movement associated with underground fires and heatings. The latex itself is based on water and is said to be completely non-flammable.

"When stoppings are treated, it should never be forgotten that a great deal of the leakage is not through a stopping itself but around it and through cracks in the vicinity. So always spray well around the sides and top and carry the spraying at least a couple of yards back on the walls and roof; put some loose packing in any cracks you can find and spray them over. If there is any loose dirt on the floor, dig it away in front of the stopping, leaving a sloping face to the trench—and spray that as well.

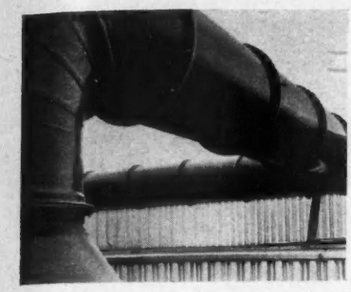
"The sort of spray equipment we have used works very well [Aerograph DeVilbiss equipment]; it is the same as that used to apply car underbody sealant. At 60 to 80 lb per sq. in with a $\frac{3}{8}$ in gun you will require rather less than 50 cu. ft of air per min.

"The time taken for the sealant to set will depend on the thickness that has been applied and such other factors as temperature and humidity and the quantity of air flowing past the seal. On the surface the sealant applied to sandbags is touch dry in about an hour, but underground in humid still conditions it may take up to 24 hours. Care should be taken not to damage the seal until it is dry, although, of course, any accidental damage can easily be patched up. Once it is dry it will stand up to pretty well anything except a runaway train."

Dunlop Chemical Products Division, Chester Road, Erdington, Birmingham 24.

Pvc Coating Protects Duct

Some ducting at Courtauld's Fibro manufacturing plant has been given an anti-corrosive coating by dipping in pvc. The ducting, shown in the illustration, is part of the degassing plant and carries 5,000 cu. ft per min of air saturated with water vapour and containing carbon disulphide and hydrogen sulphide.

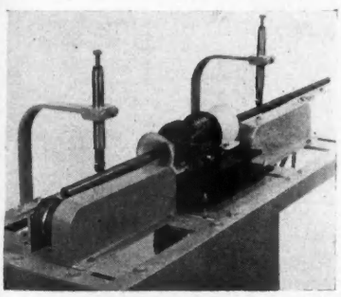


British Geon, who supplied the Geon 121 pvc paste used for the dipping, claim that this process cuts out the costly handwork involved in rubber coating and allows greater control over the thickness of the coating. Intricate bends and awkward shapes can also be lined seam free.
Coating carried out by Plastic Coatings Limited, By-Pass, Guildford, Surrey.

BNF Annual Report –Copper Tube Test

British Non-Ferrous Metals Research Association draw attention to two trends which are notable in its annual report published last month. First, side by side with its fundamental research, more attention is being given to development work and short-term specific researches with a view to passing on results as quickly as possible to industry.

Secondly, there is increasing activity among the primary producers to promote international research into further applications for non-ferrous metals and their alloys; the trend to international cooperation in research on copper, cobalt and zinc has led to placing of contracts with the BNF.



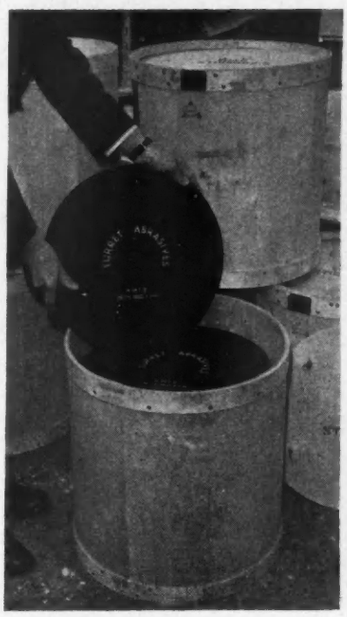
One of the less publicized projects which shows great promise is the development of a method for testing copper tubes. This is being pursued in the physics laboratories and is said to be in operation already in the works of a large British producer of copper tubes, though the extent to which it is being used and accepted as a test is not revealed. At present, many specifications for copper alloy tubes demand that the tubes should all be hydraulically tested, which BNF comment is a laborious, time-consuming process. The BNF system depends on the use of eddy currents to detect cracks and manufacturing faults in tubes.

This test method appears to depend for its action on detecting differences in eddy currents induced in two coils placed side by side through which the tubes are passed. Electronic equipment has to be used to generate a primary signal and to analyse the resulting signals, but the speed at which it operates is such that a double accept-reject run-out table can easily be operated to automatically sort good tubes from bad. BNF comment that with the present configuration of stationary coils they are fairly confident in being able to know what sort of defect is being detected so that tubes can be rejected only for selected defects. This apparatus is said not to detect defects which run throughout the length of the tube as it depends on detecting differences between adjacent portions of tube. In other words it will not show up longitudinal cracks and probably not out-of-specification wall thicknesses.
British Non-Ferrous Metals Research Association, Euston Street, London NW1.

Plywood Barrels Reduce Freight Costs

By using plywood barrels weighing 11 lb in place of chestnut kegs weighing 91 lb an exporter of cut-off wheels is saving freight costs. This is reported by Venesta Plywood who make the barrels—as shown here—for Turret Grinding Wheel Company of Sunbury-on-Thames.

The plywood barrels are claimed by Venesta to be strong and rigid yet lightweight. Their overall dimensions are 20 in by 18 in, thus occupying relatively little space, in fact, 3 cu. ft. The previous method of packing was using



standard chestnut kegs. These had overall dimensions of 36 in by 27 in, held twice the number of wheels, but occupied four times the space.

The cut-off wheels are 16 in in diameter by $\frac{1}{8}$ in thick and are packed in quantities of 100 in each barrel, sawdust or wood shavings being used as a packing material. The total weight of the packed barrel is about 2 cwt.

These containers are used for exporting the cut-off wheels to Sweden.
Venesta Plywood Limited, Vintry House, Queen Street Place, London EC4.

Pipe-Sealing Balloons

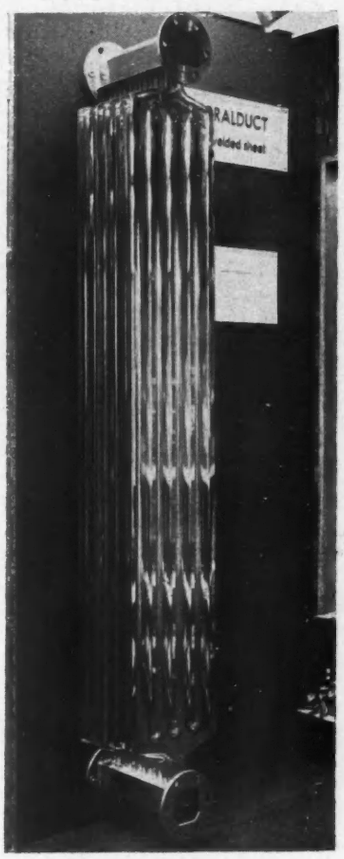
Inflatable balloons for use by the UK Atomic Energy Authority in sealing gas pipelines while maintenance work is in progress have been developed by George MacLellan and Company.

The balloons, nine of which have been supplied to the Authority, are 54 in in diameter and are made of strong rubberized material. When inflated they effectively seal off any section of a pipe requiring attention, say MacLellan. As heat is present, the balloons have been fitted with release valves to allow for air expansion.
George MacLellan and Company Limited, Shuna Street, Glasgow NW.

Transformer Coolers from Integral Sheets

When discussions were held with ICI and Impalco in preparation for an article on heat exchanger sheets, these companies revealed that they had considered their Tube-in-Strip for making transformer coolers. Hence it was interesting to note that a second firm who make such integral passage sheets should have shown a cooler at the Electrical Engineers' Exhibition held last March. It is shown below.

This illustrates how Noralduct, made by Alcan Industries, may be fabricated into an oil-cooling assembly for power transformers. Two joining methods were used: argon-arc welding and adhesive bonding. This was made for the exhibition referred to above.



Further information on these heat exchanger products can be obtained from the article (ENGNG., 11 Nov. '60, p. 634) and from the makers. The product used by Alcan Industries is made in sheets with patterned ducts in them—note the header arrangements—but it may be worth recording that ICI and Impalco had considered using their standard Tube-in-Strip product as well as their sheets with patterned ducts. Tube-in-Strip is strip metal with one or more parallel circular holes along its length; hence separate off-takes are required on each duct. For transformer coolers strip could be used with more than one duct and louvres cut into the surrounding strip.
Alcan Industries Limited, Banbury, Oxon.
ICI (Metals Division) Limited; and Imperial Aluminium Company Limited, PO Box 216, Witton, Birmingham 6.

Control Developments from Mesucora

By C. J. Charnley, B.Sc. (Eng)
The College of Aeronautics, Cranfield

This report from the recent Mesucora Exhibition and Congress in Paris highlights some recent developments and some present trends in the fields of measurement and automatic control.

THE Exhibition and Congress which were held concurrently from the 9 to 17 May, represent the first major French exposition in the field of measuring instruments and automatic controls. The title MESUCORA is derived from abbreviations of the words MESUre (measurement), COntrôle (checking and inspection), Regulation (regulation) and Automatisme (automation) and, as with the title, so with the exposition, the main emphasis was on measurement.

The exhibition, with over 600 exhibitors, was held in the remarkable building of the Centre National des Industries where it was opened by M. Jean-Marcel Jeanneneny, the French Minister for Industry. Some idea of the striking appearance of this building, which has a triangular planform and fluted concrete arch roof, can be seen in Fig. 1 and Fig 2.

The Congress, which was held in the Salle d'Iena several miles away across Paris, consisted of 42 papers, concerned with new measurement and control equipment for a wide range of applications and presented by specialists from several countries. The opening address was by Professor A. Leaute, of the Academie des Sciences, followed shortly afterwards by Mr. L. A. Woodhead, the President of the Scientific Instrument Manufacturers Association, with the first of several interesting British contributions. Mr. Woodhead's paper was entitled, "The increasingly rapid advance in technical knowledge", and outlined the progress that has been made, particularly recently, together with a forecast of future developments.

Another extremely interesting British contribution was by Dr. J. Thomson, Director of the British Scientific Institute Research Association, who described some new devices which have been developed by his research association. These included a phase difference ultrasonic flow meter for use with liquids, a position sensitive photocell which has possible applications in machine tool control, and a glass phosphor which may be useful to the nuclear power engineer for the detection and measurement of intermediate and high energy neutrons.

As was to be expected, a very large number of the contributions concerned new developments and applications in the fields of electronic and nucleonic measurement, together with papers on the automatic storage and handling of numerical information. Not quite so expected, but obviously relevant, was a series of papers on the control of quality in production, one of them by Mr. D. J. Hewitt of Solatron.

An extremely interesting paper was presented by M. J. Babaud of the Ateliers de Construction de Bagneux, dealing with "The graphical recording, with electrical intermediary, of rapidly variable pressures and accelerations." The method was extremely simple and consisted of marking fine traces on a magnetic tape as it was passed in front of a diamond stylus, which is rather like a gramophone needle. The trace can subsequently be viewed and, if necessary, photographed after optical magnification.

The session on servo-systems and components produced several good papers, including one describing a new motor using a printed coil winding. It is claimed that this method of construction gives a very low rotor inertia and a short time constant, making it particularly suitable for inching controls such as in a punched tape reader, where it can operate at up to 80 steps a second.

The two final sessions dealt with Regulation and Automation respectively, including papers on "The basic problems in the automatic regulation of manufacturing machines and Installations", and "What is an Automaticien?" This latter paper provoked a most lively discussion, since the training of "Automaticiens", (probably control engineer is the nearest English equivalent), and the problems of education and training for automation are as much in people's minds on the continent as here.

THE EXHIBITION

Turning to the exhibition, it was noted again that the main emphasis was on measurement and that, very surprisingly, there were only three stands showing machine tool control equipment. Approximately half of the 630 exhibitors were French followed by Western Germany (110), U.S. (70), Great Britain (55) and Switzerland (40). Process control equipment, both electronic and pneumatic, was much in evidence and there was also a great deal of interest in process control computers and data logging equipment. Progress in this latter field has been stimulated by the installation of computer control and data logging equipment in the new nuclear power stations which are being built.

The machine tool equipment was relatively simple in character, but this and its low cost may add to its appeal to small and medium sized businesses. One of the systems of particular interest is a programme controller, which has been developed by A.O.I.P., of Paris, using pneumatic or hydraulic actuators. The controller initiates one or more movements, which then continue to the end of the stroke, when a contact is made causing the controller to initiate the next sequence; time delays can be introduced.

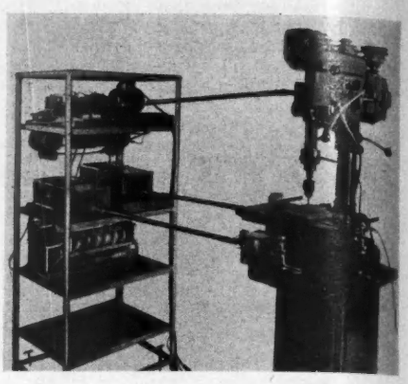


Fig. 3 The control equipment for drilling machines developed by the Centre de la Recherche Scientifique.

Another system has been developed by the Centre de Rechèrches Scientifiques Industrielles et Maritimes de Marseille to enable a form of positional control to be applied to drilling machines without the need for extensive modification. As can be seen from the illustration of the prototype in Fig. 3, the equipment is brought to the machine tool on a trolley and connected to the various movements by means of shafts. The information is given in the form of a wide roll of paper into which holes are punched for the different movements.

One other interesting development was the Prototypia equipment shown in Fig. 4; this was a kind of precision Meccano set which can be used for building research and development models. It would appear to be useful in technical colleges and research establishments.

As a final example of the thinking underlying both the Congress and the Exhibition, one could cite the Automatic Meteorological Station which has been developed by the Société Industrielle de Telécommande et de Teléméchanique. This station is intended to be placed in out of the way parts of the world where it will measure, record and transmit automatically, at fixed times, the state of the weather, including temperature, humidity and wind velocity and direction.

Fig. 1 The impressive exterior of the exhibition hall.

Fig. 2 Some of the exhibition stands.

Fig. 4 The Prototypia kit (above) in its compact box and (below) being used in a vibration study.

Regulation and Distribution with Lurgi Gasification

In introducing the Lurgi process of high pressure gasification at their new Westfield, Fife, plant, the Scottish Gas Board have made necessary a fresh approach to the problems of controlling the production and distribution of gas. The process is not only revolutionary in its use of low grade coal—the main feature making it a particularly economic proposition—but also in its requirements for automatic control equipment during production and for gas regulating valves in the high pressure "supergrid" distribution system.

The automatic control valves and liquid level controllers in the actual plant are similar to types used in oil refineries, chemical plants and other process industries. Pneumatically operated, the valves respond to a 3 to 15 lb per sq. in signal from an automatic controller. The level controllers are used in conjunction with a control valve to maintain specified levels in process vessels independently of changes in flow rate. Both valves and level controllers have been supplied by the Fisher Governor Company Limited, a member of the Elliott-Automation Group, who have also provided the distribution grid control equipment.

This latter equipment is completely new to this country in that the valves are operated by the pressure of the gas in the system, not by compressed air as in the Lurgi plant itself.

In the supergrid system the transmission line pressure is 250 lb per sq. in, a pressure which is reduced and controlled in one stage to 25 lb per sq. in through two regulators arranged in series. The first regulator functions as an over-ride or monitor for an active regulator controlling the pressure and volume of gas into the downstream system. Continuity of supply is thus ensured.

By-pass systems are incorporated in the grid and it also has relief stations to provide a back-pressure or relief system preventing excess pressures in the pipelines. Gas can be passed into a secondary system when pressure in the grid is greater than the safe limit.

Another Elliott-Automation Group company, Elliott Brothers (London) Limited, have installed the complete instrumentation system for the transmission of data on inlet-pressure, outlet-pressure and rates of flow at the ten governor stations which control gas flow from the supergrid to the local distribution holder stations. Information is transmitted to the Westfield plant where the central control room contains recording instruments, alarm indicators and flow integrators. Later stages will bring information from the local holder stations.

The receiver panel has been designed with each bank of instruments relating to one station plugged into a central 3 in trunking, which runs the length of the control room and is completely wired and fitted with station sockets. Further stations can be added to the panel, as they become operational, simply by removing the blanking plates on the panel face, fitting the receivers and connecting the appropriate leads.

Other important ancillary plant at Westfield includes Simplex Mono Recorders, made by James Gordon and Company for the analysis and recording of carbon dioxide, and a new type of final gas meter, made by Sturtevant Engineering, which gives equally accurate metering in either high or low pressure lines.

Blueprint for Integrated Flow Production of Steel

Spencer Works, the new integrated iron and steel works which Richard Thomas and Baldwins are building at Llanwern, near Newport, is to produce, during the first phase of operation, 1·4 million tons of steel ingots a year, mainly for hot rolled and cold reduced steel plate suitable for car bodies, refrigerators, washing machines, drums and light engineering generally. The site is 3¼ by 1¼ miles in area and, as shown in the illustration, the whole plant is being laid out to provide smooth production flow from receipt of raw materials to dispatch of finished goods.

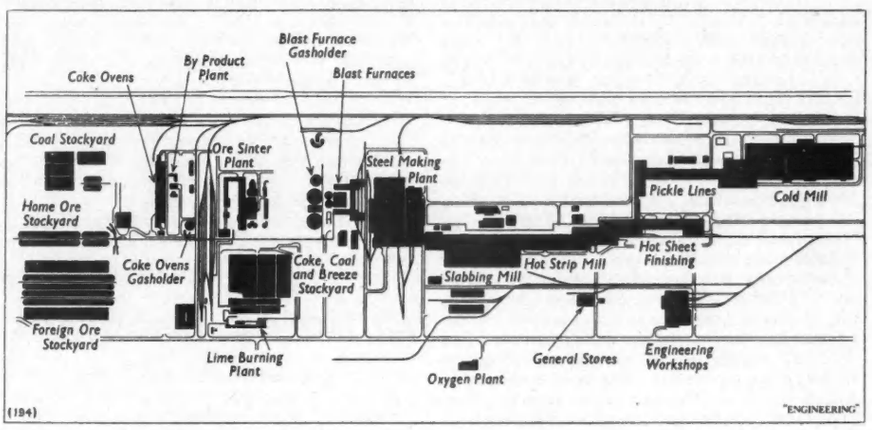
The raw material stocking and preparation areas are on the left of the illustration. Into this area will be fed, each year, 1 million tons of coal, 600,000 tons of lime and limestone, 300,000 tons of dolomite, 4 million tons of iron ore and 170,000 additional tons of coke. The iron ore will mostly be imported at Newport Docks and the bought-out coke will come from National Coal Board carbonizing plants in South Wales. The further essential raw material, replacement water, will be obtained from the River Usk and the Severn Tunnel springs at a rate of 14 million gallons per day. A specially constructed reservoir of 100 million gallons capacity will store the "soft" water, while "hard" water will be piped eight miles from the Severn Tunnel.

From the raw material storage area, coal will be passed to 140 coke ovens each holding 18 tons and sited in one of four batteries of 35 ovens. Throughput of coal will be 21,000 tons per week to produce 18,000 tons of coke and breeze and 200 million cubic feet of gas. A by-products recovery plant will extract tar, sulphate of ammonia, benzole and naphthalene from the gas, which will then be used as a fuel.

Next in line is a three-strand sinter plant where all ore for the blast furnaces will be processed to provide an improved charge. Initial output in this department will be in the region of 70,000 tons of sinter per week.

At the next stage of production, two blast furnaces of 30 ft hearth diameter will each turn out 2,000 tons of iron a day. These will be the first blast furnaces in this country to be charged solely by automatic methods. Ancillary equipment will include six hot-blast stoves, blowers and gas cleaning plant, and here, too, the gas produced will furnish a fuel supply within the works. Molten iron from the furnaces will be carried in ladles to two 1,200 ton storage vessels or "mixers", from which the steel plant will draw material.

The Spencer Works will be unique in that its steelmaking process will make exclusive use of the LD system in which the iron is refined by top-blowing pure oxygen. During this top-blowing, the molten iron will be contained in three 100 ton capacity vessels and will be served by three 200 ton oxygen plants.



The layout of the new steel works, showing the relative positions of the principal production and ancillary units. Flow is from left to right the distance being 3½ miles.

To bring the ingots from the steel plant to the correct temperature for slab rolling, there will initially be 20 soaking pits. Ingots of 10 to 15 tons will not need to be turned on their sides for slab rolling since the universal slabbing mill will be equipped with both horizontal and vertical rolls. The slabbing mill will be powered by 16,000 hp electric motors, an automatic scarfer will dress the surfaces of the hot slabs, and the plant will be able to deal with slabs up to 30 ft long.

The crucial next stage in production, the hot-strip mill, will be remarkable for two reasons. First, it is the only mill of its kind outside the USA, and possibly Russia, designed for full automatic handling from the reheating furnaces to the coilers. Secondly, being 2,800 ft long from the beginning of the approach table to the coilers, it will be longer than any other two existing hot mills put end to end. It is a 68 in wide mill designed to roll strip at 3,000 ft per minute and, initially, its principal units will be two slab-reheating furnaces, scale breakers and roughing mills, a six stand finishing mill driven by 47,000 hp motors, and two down-coilers. During phase one of operation, 1·2 million tons of slab steel will be processed in addition to 400,000 tons of slabs for the Steel Company of Wales.

Associated with the hot-strip mill will be a hot-sheet finishing department capable of cutting hot rolled coils into sheets and plates up to ⅜ in thick. Hot mill finished sheet can also be dispatched direct to customers in coil form, but the main output will be passed to the adjacent cold reducing mill.

The main units in the cold mill will be a continuous pickling line—said to be the first of its type outside the USA—with an acid recovery plant, and a four-stand cold reduction tandem mill able to roll at up to 4,000 ft per minute to finished widths of up to 60 in. Other equipment in the department includes coil annealing furnaces larger than any in the country, two high speed temper mills, high speed cut-up lines with magnetic piling of the cut sheets, and oiling, inspection, packing and dispatch units.

Thus, from beginning to end of the complete production process, high utilization of the technically advanced production equipment is ensured by a direct flow line and up-to-date handling methods.

When the first phase of production begins—probably in April, 1962—5,500 people will be employed at the new steel works. The final cost of the project is not yet known but Richard Thomas and Baldwins make it clear that the works will be a commercial proposition whatever may be its future ownership.

On the Shelf

By Frank H. Smith

My old friend at Toledo (US) public library has thought up a scheme to speed publication. An author, as soon as his script is done, selects one or more relevant titles from a list. He then takes it to a recording centre (and Toledo visualizes a thousand or more throughout the States) which is connected to all others by closed-circuit television. The manuscript is recorded, visually, on electronic micro-tape. A master computer sets up code signals, linked to author's name, address and subject titles. Then any scientist anywhere in the network can dial call numbers for the subject in which he is interested and get, on his screen, the latest publication in his field. I just offer this without comment. One drawback I can see, however, is the term Toledo has chosen. It is Telepub! No comment.

The Multi-Science Publishing Company, 33 South Drive, Brentwood, Essex, tell me that the first issue of *Electronics and Communications Abstracts* will appear in September. Six issues a year, with annual index by subject and author. If you order before 31 July—£7. Otherwise £10. Single issue £1 10s 0d. Mr. B. R. V. Hughes is the man at Brentwood.

In these days of King-size takeovers, it is refreshing to hear a publication announce its last number with triumph. With the near-opening of the new National Lending Library for Science and Technology, at Boston Spa, the DSIR's *LLU News* is dead and will be replaced by *N.L.L. News*, to be "issued as occasion demands" to all those who have received the LLU job. It will be as well to hang on to No. 6 of the *LLU News* as it has a lot of dope about the Spa setup. I think I'll stick to referring to it as the Spa. Boston might mean that or Stump or Teaparty—or even cakewalk, if you are old enough to remember it.

I am pretty sure that *Bulletin Signaletique* is an abstract bulletin (abstract meaning abstracted, not the converse of concrete), and from the Centre de Documentation du Centre National de la Récherche Scientifique comes a booklet which gives particulars of their 22 fascicules. I cannot list all 22 sujets that they couvrent but they include mathematique, sciences de l'ingenieur, chimie, two sorts of physique and deux of sciences de la terre, and so on. They can be souscrits to, separately, together, or in either of two lots of eleven, for which there are lower rates pro rata (they are conveniently split rather like *Procs. Roy. Soc.* A and B). The address is 15, quai Anatole France, Paris.

If you are chasing back numbers or odd files of periodicals, Scientific Book Supply Service, 10 Birkbeck Hill, London, SE21, has a new list (No. 34) off the press.

I am sure you all know what a Bucherverzeichnis is. A natty little one covering Mathematik und Physik comes from R. Oldenbourg-Verlag of Munchen 8 (Rosenheimer Strasse 145).

The Sheffield City Libraries are kindly consistent in sending me the accession list of their Libraries of Commerce and Technology. This is in UDC order, which makes for strange bedfellows such as the Home Office *List of Authorised Explosives* followed by the *Food Buyer's Yearbook 1961*. The latter is under 664 (Food Technology) but *The Art of Chinese Cooking* is back under 641—miles away under Food. I just love *Oyster Cultivation in Britain* under Hunting and Fishing Industries. Ever been oyster huntin'? You do it on sea-horses. With dogfish. Seriously, though, they do mention a bibliography, and you know what I am for them. *Cutlery: a Bibliography*, by Sheffield City Libraries. Now that sets off a train of thought. I wonder if Swindon Library does railways, Northampton (or Leicester) does shoes, Luton does hats, Grimsby does fish, or Richmond does Maids of Honour? Silly me.

Electrical Machines

Transformers and Generators for Power Systems. By R. Langlois-Berthelot. *Macdonald.* (65*s*)

The two parts into which this book is divided—each a sizeable work in itself—are concerned respectively with transformers and with synchronous generators. In each, the behaviour of the equipment under both normal and fault conditions is considered in some detail, though without extensive development or explanation.

Each part also contains sections devoted to insulation, form of losses, methods of cooling, transient behaviour and guides to specification and operating engineers. Finally, many useful references are given and pertinent articles appearing during the past ten years in the proceedings of various institutions are grouped under subjects with a synopsis of each.

The first part, which is devoted to transformers, begins by considering various types. The conventional equivalent circuit of a single-phase transformer is derived and it is then shown, considering the balanced case only, that this circuit applies for a three-phase transformer. But no description of the three-phase transformer is given, so that the student reader might well be at a loss to understand the discussion of free and forced flux arrangements.

Both single and three-phase auto and three-winding transformers are next briefly considered. Reactances are derived in a per cent system which is explained and used throughout—much confusion could be avoided and simplification achieved by conforming to the universally adopted per unit system.

The main aspects of network problems involving transformers are next considered with many examples of power-system problems. The chapter devoted to winding arrangements is brief indeed, while the chapter on insulation discusses at great length many aspects of overvoltage, breakdown and testing procedure which are of a highly specialized nature. The remaining chapters include surveys of losses, methods of cooling, effect of abnormal operation and features of special-purpose transformers.

In Part 2—"The Synchronous Machine"—no attempt is made to describe the machine nor to explain the mode of its operation. Vector diagrams are immediately drawn without a true explanation of their meaning as representing imaginary sine waves of flux within the machine. The first chapter rapidly considers a multitude of machine conditions, in the main for the unsaturated round rotor machine but including briefly (and very inadequately) the effect of saturation and saliency. It is remarkable that any presentation of the theory of synchronous machines should be attempted in fifty pages—the book attempts the impossible and in fact merely serves to enumerate the aspects of synchronous machine study.

As in the first part, much space is given to consideration of insulation, losses and cooling and to a study of transient conditions.

The reviewer can perhaps be forgiven for thinking of the book as a result of the Chinese type of examination where the entrant is asked to write down all he knows. Certainly, Mr. Langlois-Berthelot knows a great deal but such diversity of knowledge will only be required by men in his own field—the operating and specification engineers for whom the book is partly intended. The other intended reader—the engineering student—would find this an unhelpful and unreadable book. Rather is it an encyclopaedia in its field, though its well thought out arrangement of chapter and section lack adequate page reference.

The book is a curious combination of many facets of engineering with a minimum, indeed a lack, of explanation and description. The field covered is, one feels, far too large to do it justice in one volume.

D. S. Ashworth

Building Becomes a Science

Constructional Steelwork Simply Explained. By Oscar Faber. 4th Edition, Revised by John Faber. *Oxford University Press.* (10*s* 6*d*)

Applied Building Construction. A Third Year Course. By Anthony Medlycott. *Chapman and Hall.* (25*s*)

Hyperstatic Structures. By J. A. L. Matheson and A. J. Francis. Volume 2. *Butterworths Scientific Publications.* (60*s*)

Symposium on Durability and Weathering of Structural Sandwich Constructions, San Francisco, October 1959. ASTM Special Technical Publication 270. *American Society for Testing Materials, 1916 Race Street, Philadelphia 3, Pa.* ($3, *members* $2·40)

The Federation of Civil Engineering Contractors: Handbook, 1960-61. *The Federation, Tufton Street, London, SW1.* (12*s* 6*d*)

In olden days building was a craft. Today it is much more complex and is broadly based on technological research. The simpler kinds of building still require old techniques; brick walls are still built by laying one brick upon another. Larger buildings need the complicated calculations of the structural engineer, the new metals of the metallurgist and the plastics of the chemist. During the last 15 years this use of new materials and techniques has increased very rapidly. Who would have thought 30 years ago of using the complex shaped shell roofs of today, or of cavity walls of thin plastics?

It is probable that the greatest strides have been made in the use of reinforced concrete. Research was actively carried out in the 30's, 40's, and 50's in the universities and elsewhere, and as a result many new forms of construction have been evolved. Methods of stress analysis and design have kept pace with these new types of construction, and a structural engineer now requires a little more than $\frac{WL}{4}$ or even $\frac{wL^2}{12}$. The structural steel skeleton has developed in the light of plastic theory; welding and friction bolted joints have partly replaced the riveted connection.

In the field of properties of structural materials, however, there has been no such great advance. Very little research has been carried out, and if design methods are not to outstrip our knowledge of the behaviour of the materials, much more effort must be applied to research in this field. It is of little use being able to calculate the deflection of a member in terms of its EI if one does not know the value of E for the particular material and the effect of age, humidity, temperature and loading history upon this value.

The books under review cover a wide range from building as a craft, simple steelwork design, to advanced structural analysis. The fourth edition of the late Oscar Faber's book *Constructional Steelwork Simply Explained* has been revised by John Faber in the light of the 1959 British Standards 15 and 449. The Faber tradition of clear exposition with good illustrations is well upheld in this book for the junior designer and should form a firm basis for more advanced studies. The addition of a list of other books would help such studies.

Medlycott's *Applied Building Construction*, Part 3, covers more general building construction. Many sketches of details for skylight surrounds, corrugated roofing fixtures and so on are included. Certain of these sketches will not find universal agreement among structural engineers: is it considered good practice to support the whole of an external scaffold upon

the projections of window sills? Again the treatment of column bases may appear somewhat dated to the engineer dealing with foundations. Chapters concerned with hot water services and drainage are short compared with that dealing with fencing and surely call for wider treatment in a book aimed at the third year certificate student. One wonders whether such a student will consider that this book contains sufficient for his 25*s*.

The advanced analyses of structures are covered in *Hyperstatic Structures* vol. 2; surely the authors are over modest in describing this work as an " introduction " to statically indeterminate structures. The book is rather unusual in that it consists almost completely of worked examples and examination questions with answers. These cover a very wide range of problems in the realms of indeterminate structures which form the greater part of present-day structural engineering. These examples are related to the chapters in Volume 1.

This book is obviously one for the final year honours student who will find therein much to broaden his engineering outlook, beside the purely mathematical techniques of computation. The examples will enable the senior engineers to acquire new techniques more readily from a textbook without the aid of lectures and tutorials. The volume itself is very well produced the only apparent error being the omission of letters on Fig. 5.36. At a cost of £3 it is a very good book to begin one's final student year.

New materials of construction are covered in a very specialized group of papers forming the symposium on *Durability and Weathering of Sandwich Constructions*. These sandwiches consist of two layers of metal, wood or plastic separated by a honeycomb to which they are attached. This structure makes for a high strength-to-weight ratio and good insulation. The papers are mainly concerned with the resistance of such materials to weathering in the United States, where conditions appear to be more severe in many respects than in England.

This type of construction has been mainly used in aircraft in recent years because of the high strength-to-weight ratio. With buildings going ever higher and the need for better insulation sandwich panels will be increasingly used in normal buildings. The tests reported in this group of papers are all of short term compared with the normal life of a building.

The materials range from large transparent domes for aircraft and aerodrome control towers to plastic and metal faced panels for aircraft and small buildings. In some cases the adhesives failed, mainly through moisture, particularly in some units recovered from aircraft submerged in the sea.

In general the type of unit suitable for inclusion in, say, a modern office block would seem to give a satisfactory performance. This is a book of greater interest to the research engineer or chemist than to the contractor, containing detailed information of the adhesives used for connecting the face panels to the cores of the sandwich.

The last book is of a different nature. It is the *Handbook* of the Federation of Civil Engineering Contractors and is full to overflowing with the sort of information a contractor or his agent requires in day-to-day office work. Items covered include legal requirements, day rates for small tools and equipment and much else which is not available from other sources. A new edition of the handbook, which is available to non-members of the Federation, is shortly to be published. At 12*s* 6*d* the present edition is very good value and well worth investigation on this point.

J. M. PLOWMAN

Riders and Machines for Track and Scramble

BP Book of Motor Cycle Racing. Edited by MURRAY WALKER. *Stanley Paul.* (8*s* 6*d*)

The large fuel and oil companies support many forms of motorcycle and motor sport, and their year books, which are issued free, mainly as advertisements, during the year, are well known. *The BP Book of Motor Cycle Racing* under review here should not be confused with these yearly publications. Here is a perfect introduction to the sport of motorcycle racing.

The book is edited by Murray Walker, who was at one time a well known rider, and is now one of the foremost journalists and commentators on motor-cycle racing. It is certainly not an advanced book, but that does not mean it is not written for adult reading. At the same time, however, it is suitable for any boy interested in the sport.

The opening chapter covers the first half of the century of motor-cycle racing, beginning with the 1905 race held near Paris. The race was won at 54 miles an hour for five laps of a 33½ mile circuit. The editor then tells the familiar story of the Continentals being allowed to develop their early machines without restrictions by the authorities, while in Britain development was hamstrung by speed limits of first 12 miles an hour, and then 20 miles an hour.

But in 1907 the Isle of Man authorities, who had been approached by the British Auto Cycle Club, gave their approval for a race meeting to be held on the Isle of Man roads, and in that year the first of the famous tourist trophy races were held. About the same time Brooklands was opened, and British motor-cycle manufacturing companies were given a chance to develop their machines on the same terms as the Continentals.

The editor states that the advantage of having the Isle of Man mountain circuit gave Great Britain the opportunity of breeding the men and machines that kept us in a dominating position in motor-cycle racing all over Europe for twenty years. It was only just before the Second World War that the Italian Guzzi and German DKW and BMW machines began to vanquish the Velocettes and Nortons.

Mr. Walker observes that the motor-cycling world championship rider series founded in 1949 helped to increase the public's interest in motor-cycle racing. On the other hand, the motor-cycle Formula 1 (production over-the-counter machines) has had the opposite effect as far as manufacturers are concerned. He then discusses the future of the sport, which is now going through a rather thin time, pointing out that enthusiasm is certainly not lacking. In the same chapter some sensible words of advice are given to the young and uninitiated enthusiasts who may want to start racing.

The second chapter discusses many of the familiar names in the sport such as Geoff Duke, John Surtees, Mike Halewood, and many others. Many of their oustanding victories are reported in detail and the reader is also given an insight into their personalities. The next chapter features short articles on all the leading motor-cycle factories which are, or have been, in the racing business. Short notes on the development of certain machines and accounts of some of the successes are also presented.

The last four chapters are devoted to motor cross (scrambling), post-war records, circuits, and some post-war facts and figures. The book is lavishly illustrated with some 150 action photographs and portraits of outstanding drivers and machines. There is admittedly little really serious technical information in the book, but as an introduction for the engineering student who knows nothing of motor-cycle racing and its history, and requires a basic knowledge before delving deeper, it has much to offer.

BRIAN LISTER

The Wizard Unmasked

Edison: a Biography. By MATTHEW JOSEPHSON. *Eyre and Spottiswood.* (42*s*)

Now that AEI has caused its member firms to lose their identity and individuality under the cloak of its initials the names of Edison and Swan are being forgotten in this country. It is a pity, because the Edison and Swan United Electric Light Company was not only the first commercial lamp manufacturing firm in Britain, but it also symbolized the coming-to-terms of two pioneers of the industry. Edison claimed that he was the first inventor of the electric lamp; Swan claimed that he had made workable lamps four or five years before Edison came into the field.

Such rivalry could only end in costly litigation, and as a result of wiser counsels they decided to amalgamate for the British market. As a matter of record, it was Lane Fox who anticipated both Edison and Swan in his patent of 1878, but that is another story.

Edison will be remembered mainly for two great contributions to social advancement—the lamp and the phonograph. In fact he was a born inventor, and during his most fruitful period from about 1870 to 1890 nearly a thousand patents poured from his laboratory. He turned his hand to anything that seemed to be of potential value—telegraph apparatus, telephones, dynamos, power systems, motion pictures, and even wireless transmission and reception. He slipped up here, as he sometimes did through impatience or conflict of interests, and the effects that he noticed were left to be developed by others. The passage of a current through the vacuum from the filament of one of his lamps, known now as the " Edison Effect," was left uninvestigated and Sir Ambrose Fleming exploited it later as the principle of the thermionic valve.

During his lifetime Edison was eulogised as the world's greatest scientist, " the master inventor," the " Wizard of Menlo Park " (where he built the first industrial research laboratory), but he had his detractors among the orthodox scientific fraternity. They dubbed him " the great empiricist," the " accidental inventor," and suggested that he was bluffing in many of his claims to have solved problems that academic minds had pronounced impossible of solution. When he announced that he had solved the problem of the subdivision of the electric light, that is to say, had devised a system of operating lamps in parallel, Sir William Preece (chief engineer, GPO, 1879) said " a subdivision of the electric light is an absolute *ignis fatuus*," and even Lord Kelvin and John Tyndall doubted whether Edison could justify his claims.

How did Edison succeed so many times in achieving the presumably impossible? In the first place he was seldom troubled by theoretical considerations. In his early days he had tried to study mathematics by reading Newton's *Principia*, and this put him off theory for the rest of his life. He then turned to Faraday and in him he found the master experimenter " whose laboratory notes communicated the highest intellectual excitement," and who thereafter

served as his model. The practical experimental approach to a problem appealed to him above all theoretical reasoning, and he seemed to solve it by a mixture of intuition and knowledge of relevant facts accumulated by voracious reading. Secondly, Edison had the gift of intense application to the job in hand. When developing the electric lamp he worked day and night for months, sparing neither himself not his staff. As one of them said "Edison could never understand the limitations of the strength of other men because his own mental and physical endurance seemed to be without limit."

It was not uncommon for him to work in his laboratory for eighteen hours a day, and the story goes that he spent the greater part of his wedding-day in his laboratory and had to be reminded to go home to his bride!

In money matter he was at times quite unsophisticated, and at others very much aware of the value of his inventions. He was frequently cheated, and at one time on the verge of bankruptcy—a stimulus to further invention.

Towards the end of his active career he became a firm friend of Henry Ford, whom he had known for a long time and who almost worshipped him. Ford conceived the idea of reconstructing Edison's laboratory in its original condition at Dearborn, and spent a prodigious amount of time and money in assembling the original apparatus. The crowning point in this re-creation came when Edison in October, 1929, demonstrated on the actual pump how he made the first electric lamp 50 years previously.

During the years before the First World War Edison, as the grand old man of American science, became (in the estimation of some) an oracle on all subjects connected with it. On education he pronounced "I wouldn't give a penny for the college graduate, except for those from institutes of technology—they aren't filled up with Latin, philosophy, and all that ninny stuff." He would have found sympathisers nowadays.

He died on 13 October, 1931, in his 84th year. He had seen, or been personally responsible for, most of the important advances in electrotechnology. He had founded the General Electric Company, a motion picture company, a phonograph company, and a public utility company. His signature was known throughout the world—that legible script that he had cultivated in his early days as telegraphist—and his position as America's greatest technical genius was unquestioned.

Mr. Josephson's biography of Edison can truly claim to be the definitive work. There have been many "Lives" of Edison written during and after his lifetime, some of them fulsomely flattering, some dealing mainly with his inventions. In this biography we have a well-documented impartial account of the whole of Edison's career and its influence on contemporary American industry.

Where the author finds material for praise he does so with discrimination; he does not indulge in eulogies—rather the reverse at times. Edison's weaknesses are not glossed over, and his real triumphs are given their true perspective.

Altogether this is a most readable book and an authoritative work of reference for all interested in the history of technology and industry. The documentation is complete and there is a good index. What more can be said in praise of a biography?

All reviewers are pleased if they can find a few flaws which mar the perfection of a work, however well performed. To point them out shows that the book has been read thoroughly! There are only two worth mentioning: the dates of various important happenings are not so well pin-pointed as they might be, and the age of Edison at various times is sometimes difficult to find. Even his age at death had to be deduced from the year and his birth date. The wonderful photograph which adorns the dust cover is not reproduced again in the book—in fact more and better photographs would have been welcome in a work of this quality. Oh—and Konrad Röntgen was a German, not a Dutch physicist.

But one's pleasure in reading through such a book is such that any criticism seems gross ingratitude to the author.

G. PARR

The Reviewers

Mr. D. S. Ashworth, B.A., is design engineer in the Turbo Generator Department, AEI Turbine Generator Division.

Dr. J. M. Plowman, A.C.G.I., D.I.C., A.M.I.C.E., was formerly lecturer in civil engineering at King's College, London, and has carried out research on the properties of building materials.

Mr. Brian Lister is joint managing director of George Lister and Sons Limited of Cambridge. He is also managing director of Brian Lister Limited, designers and makers of the Lister range of Bristol, Maserati and Jaguar engined sports cars well known on British circuits during the latter half of the 1950's.

Mr. Geoffrey Parr, M.I.E.E., was formerly with the Edison Swan Electric Company until he left to found *Electronic Engineering*, of which he was managing editor until 1949. He is now technical director of Chapman and Hall Limited, the technical publishers.

As we go to press, we learn with regret of the sudden death of Mr. Parr as the result of a heart attack. We extend our sympathy to his family.

New Books

Cermets. Edited by J. R. TINKLEPAUGH and W. B. CRANDALL. *Reinhold, New York: Chapman and Hall, London.* (76*s*)

A considerable volume of published information on cermets has appeared over a period of years in ceramic, metallurgical and chemical periodicals. In the present volume 23 contributors survey the fundamental aspects, forming and processing, testing and applications of oxide and carbide base cermets.

The Physics of Television. By DONALD G. FINK and DAVID M. LUTYENS. *Heinemann.* (5*s*)

High-grade popular exposition, appealing to the student as well as to the informed general reader. Colour television is included. Conventional descriptions of circuitry are avoided.

Great Ideas of Modern Mathematics: Their Nature and Use. By JAGJIT SINGH. *Dover Publications, New York; Constable, London.* (12*s* 6*d*)

Addressed to the non-specialist, this book examines some of the major mathematical concepts (e.g. theory of sets, group theory, symbolic logic) of the past two centuries and indicates how they are related to all the sciences and to human thought processes.

Crystals and Crystal Growing. BY ALAN HOLDEN and PHYLIS SINGER. *Heinemann.* (10*s* 6*d*)

A lively and generously illustrated account of crystallography and crystal physics, suitable for both the science student and the amateur scientist. Methods are given for the growing of 12 basic crystal types. The emphasis throughout is on the use of simple, home-made equipment.

Boolean Algebra and its Applications. By J. ELDON WHITESITT. *Addison-Wesley Publishing Company, Reading, Massachusetts, and London.* (51*s*)

The reader with a limited formal mathematical background is offered an introduction to Boolean algebra, with applications to algebra or sets, symbolic logic, and circuits (including switching, relay and computer circuits).

Soviet Research in Boron Chemistry, *1949-1956. Consultants Bureau, 227 West 17th Street, New York 11, N.Y.* ($40)

Eighty-three reports, in complete English translations, were selected from the pages of five Russian chemical journals, viz., *The Journal of Applied Chemistry of the USSR, The Bulletin of the Academy of Sciences* (Chemical Sciences Division), *The Journal of Analytical Chemistry, The Journal of General Chemistry*, and the *Proceedings of the Academy of Sciences* (Chemistry Section).

Trade Publications

Copies of any of the following trade publications are obtainable from the addresses given, though distribution is sometimes restricted.

Materials

Silicone Compound. MIDLAND SILICONES LTD., 68 Knightsbridge, London SW1. MS4 is a grease which can be used for electrical potting, as a moisture barrier, or as an oxidation preventive on natural and synthetic rubbers. 3 pp. ill.

Seam-Welding Wheel Blanks. JOHNSON MATTHEY AND CO. LTD., 73-83 Hatton Garden, London EC1. Properties and range of sizes of wheels. Wider range now obtainable from stock. 7 pp. ill.

Sulphuric Acid. POWER-GAS CORPORATION LTD., PO Box 21, Stockton-on-Tees. What the company can do in supplying plant. 12 pp. ill.

Interlay for Black-Tops. EXPANDITE LTD., Chase Road, London NW10. A 10 in wide seamless tube of polyethylene film encloses a 7 in wide strip of aluminium foil and is recommended for laying under joins in black-tops for roads. 2 pp. ill.

Metallographic Specimens. PLANNED PRODUCTS (METALLURGY) LTD., Reliant Works, Betchworth, Surrey. 139 individual specimens of alloys with descriptive technical data are obtainable in sets for university departments, etc. The range and cost. 8 pp. unill.

Die Steels. HADFIELDS LTD., East Hecla Works, Sheffield 9. Compositions of this company's offerings in the die steel line. 6 pp. ill.

Aluminium Honeycomb. CIBA (ARL) LTD., Duxford, Cambridge. 2 data sheets to supplement existing Aeroweb design information sheets.

Alumina Ceramic. LODGE PLUGS LTD., Rugby. Technical information and data on Sintox ceramics. 33 pp. ill.

Alloy Steels. HADFIELDS LTD., East Hecla Works, Sheffield 9. Specifications for this company's range of alloy steels. Two-way index from En to brand names.

Titanium. IMPERIAL CHEMICAL INDUSTRIES LTD., Millbank, London SW1. A few examples of this material's uses in textile and paper pulp bleaching. 10 pp. ill.

Adhesives. EXPANDITE ADHESIVES LTD., Birchley Street, St. Helens, Lancs. S92, S93 and S94 are three new rubber/resin adhesives. 2 pp. ill.

SG Iron. JOHN HARPER AND CO. LTD., Willenhall, Staffs. Properties of spheroidal graphite cast iron made by this company. 6 pp., ill.

Asbestos Textiles. TURNER BROS. ASBESTOS CO. LTD., PO Box 40, Rochdale. Booklet shows properties and applications of this company's asbestos textile products in the electrical field. 32 pp., ill.

Mullite Firebrick. MORGAN REFRACTORIES LTD., Neston, Wirral, Cheshire. A firebrick called M.R. Trumil can be used with safety in ordinary furnace walls with hot face temperatures as high as 1760° C. 3 pp. ill.

Crucibles, Furnaces and Foundry Assessories. MORGANITE CRUCIBLE LTD., Woodbury Lane, Norton, Worcs. An index to lists covering this company's products under this title. 3 pp. ill.

Plastics. BX PLASTICS LTD., Higham Station Avenue, London E4. Booklet introduces company's products and gives general properties. 20 pp. ill.

Arc Welding Electrodes. BRITISH ELECTRICAL AND ALLIED MANUFACTURERS ASSOCIATION, 36 and 38 Kingsway, London WC2. This is the sixth edition of this association's guide to arc welding electrodes. Equivalent American code numbers are shown in all the classified lists. 96 pp. ill, price 5*s*.

Polyester Resin. SCOTT BADER AND CO. LTD., Wollaston, Wellingborough, Northants. Crystic 197 is a low-pressure laminating resin with good resistance to alkaline materials. Data sheets. 6 pp. unill.

Aluminium. IMPERIAL ALUMINIUM CO. LTD., PO Box. 216, Witton, Birmingham 6. Technical data on company's aluminium alloys: properties and forms. Also brazing and jointing media. 67 pp. ill.

Designing in Steel. CLIMAX MOLYBDENUM CO., obtainable from European company at 2 Cavendish Place, London W1. Book by this American company discusses some good basic design ideas when using heat-treated alloy steels. 77 pp. ill.

Headed Contacts. JOHNSON MATTHEY AND CO. LTD., 73-83 Hatton Garden, London EC1. Revised data sheet on contact rivets, now made in silver and 6 alloys. 2 pp. unill.

Marketing

Alternator Sets for Remoter Russia

HAWKER SIDDELEY INDUSTRIES have added to their long experience of trade with the USSR—more than £15 million of equipment in the past 15 years—with a £575,000 order for 49 NATIONAL/BRUSH diesel alternator sets. Ordered by MACHINOIMPORT, one of the principal Government buying organizations, the sets will provide electric power for remote rural areas not on the national grid system.

Thirty of the sets are 450 bhp National R4AU six cylinder diesels with HSBT turbochargers, directly coupled to 310 kW Brush alternators, with associated control and feeder switchgear. The remaining 19 are of a similar type, rated at 415 kW and powered by 600 bhp National R4AU8 engines.

Since 1945, the Hawker Siddely equipment sent to the Soviet Union has included National diesels and diesel generating sets, Brush steam turbo-alternators and Mirrlees marine propulsion and auxiliary diesels for a fleet of new Soviet trawlers.

The company has in hand further trade discussions with the Soviet authorities.

VC10 £500,000 Order for Electrical Equipment

The new VICKERS VC10 airliners are to have hydraulic constant speed generator drives supplied by the Aircraft Equipment division of ENGLISH ELECTRIC Limited. A contract worth £500,000, for the drives and associated equipment, has been placed with the company.

More than 100,000 flying hours have been completed by the Sundstrand constant speed drives built by English Electric. The drive which has now been specified for the VC10 is employed on the Boeing 707 aircraft now flying for BOAC and for AIR INDIA.

The equipment is to be manufactured at Netherton, near Liverpool, and at Bradford. Deliveries are to begin at the end of the year.

Analogue Computation Hire in Southern England

An analogue computing centre has been set up in the South of England, at Burgess Hill, Sussex, by ELECTRONIC ASSOCIATES Limited, the wholly owned British subsidiary in Britain of the New Jersey, USA, company of the same name.

The new facilities are available on a time-rental basis for design and simulation programmes in the nuclear, automobile, missile, chemical and shipbuilding sectors of industry. Complete problem preparation, with or without assistance, full service on the computing equipment, and computer operators where wanted, are provided.

An important feature of the service which the centre makes available to UK industry is the widely diverse libraries of problems maintained at Electronic Associates' computation centres in Princeton, New Jersey; Los Angeles, California; and Brussels, which will be available at the Burgess Hill, Sussex, centre. The Princeton centre was established as long ago as 1954.

The equipment of the new centre includes a 231R PACE system of 80 operational amplifiers and detachable pre-patching panels, a TR10 transistorized desk top computer of 20 operational amplifiers, and various recording systems.

Turbo-Alternator for Rhodesian Sugar Factory

A sugar factory on the Rhodesian Triangle Sugar Estate is to have a 3,000 kW turbo-alternator built by W. H. ALLEN AND SONS, of Bedford.

The plant will be made up of an Allen steam turbine running at 6,000 rpm driving through Allen-Stoeckicht epicyclic speed reduction gearing, a MATHER AND PLATT fully enclosed water cooled alternator at 1,500 rpm. The turbine is designed to operate at a pressure of 435 lb per sq. in (g) and 606° F, exhausting to a separate basement condenser with a vacuum of 27·5 in of mercury. The turbo-alternator is to run in parallel with other generating plant at the site at 6·6 kV, three phase, 50 cycles at 0·8 power factor.

Another Moscow Trade Exhibition

Starting a day before the British Trade Fair closed, the East German Republic is holding an exhibition of consumer goods in the Gorky Park, Moscow, from 3 to 25 June. This is the first time the rapidly expanding consumer goods industry of the GDR has exhibited in Moscow and much of the show is concerned with textiles, furniture, cameras, musical instruments and sports equipment.

The exhibition is a further indication of the trend in East German-Soviet trade which has been moving towards a higher proportion of consumer goods. On the capital equipment side of their trade both the Soviet Union and East Germany have been moving up the list of world suppliers of machine tools. Czechoslovak information now puts the GDR and the USSR fifth and sixth in the world machine tool table.

Rumanian trade officials returning to Bucharest from Moscow will find the East German export showrooms in the city conducting an exhibition of machines for the food industries. This is being held by the GDR trading company DIA CHEMIEAUSRUSTUNGEN and includes an absorption type of refrigerator, a high-speed cigarette machine, retail trade display cases and various cooling systems.

Tunis Motorway Contract for BASE Group

The consulting engineers of the BASE Group, MESSRS. LEONARD AND GRANT, are to carry out a full traffic census and survey and a land and soil survey for the new motorway project which is to by-pass the city of Tunis.

The company are to produce a report, recommendations and a preliminary scheme for the road, for the Tunisian Government. The city lies on a narrow neck of land between two shallow lakes and presents considerable technical difficulties. The road, which will carry heavy vehicles moving to and from the Port of Tunis, will run partly over marshy ground and alongside the port. This part of the route is likely to be in the form of an elevated carriageway. Survey work on the 15 mile motorway is expected to be complete by the end of this year.

Linking Bizerta in the north with Sfax in the south and connecting with El Aquina, the international airport, the project is one of the keys to the growth of Tunisia.

Not So Fast in Steel Expansion

RICHARD THOMAS AND BALDWINS, the still-nationalized steel firm, are endeavouring to accelerate the speed of work at their new Spencer iron and steel works outside Newport, Monmouthshire. The rate of erection of the steel making plant has not been up to that expected and the result is that first production is now likely to start up in April of next year, and not at the end of this year as had originally been hoped. A description of the works is given in page 805.

A recent Government esimate for the works at Llanwern, whose output will be up to 1,400,000 ingot tons of steel a year, was that it would cost £119 million. Estimates based on the prices of 1958 and the first part of 1959 indicated £110 million as the cost.

RTB have so far drawn £12·1 million of the £70 million Government loans which have been approved for the new works. Another £26 million is expected to be made available to the company at the end of this month. Normal interest rates are to be paid and the money is to be repaid by 1971.

Full production is believed to be possible by the end of 1962, following starting up in the spring of the year. At a recent visit to the Spencer works, Mr. H. F. Spencer, the RTB managing director after whom the plant is named, is believed to have given a hint that the pace of movement towards full production could be intentionally checked in order to prevent the capacity developing ahead of the steel demand.

Democratic Design for Soviet Liner

A 30,000 ton passenger liner designed, according to the Soviet authorities, on new lines, "characteristic of the Soviet understanding of democracy" is now in the planning stage in the USSR.

To be a single class vessel, the new liner will be capable of carrying 1,000 tourists and have a speed of 28 knots.

More Millbank Refrigeration by Sulzer

The Millbank Development, the LEGAL AND GENERAL ASSURANCE SOCIETY'S building for VICKERS Limited and other organizations, is to have a third refrigeration plant by SULZER.

The equipment will be a Sulzer Uniturbo, with a capacity of 450 tons of refrigeration (5·4 million Btu per hr) to be used for chilling water. Two similar plants have already been ordered for the 387 ft Tower Block, the highest building now under construction in London. These will each be of 350 tons refrigeration capacity.

The total contract for the Millbank development now adds up to 1,150 tons refrigeration. The machinery is valued at £80,000.

Sulzer's Uniturbo is a Freon 12 packaged unit with automatic regulation from 100 per cent to 10 per cent load.

English Electric Offer To Buy Works Next Door

An offer worth a little over £2 million has been made by ENGLISH ELECTRIC for the complete share capital of W. H. DORMAN, the Stafford engineering company making high speed oil engines and diesel generating sets.

The directors of W. H. Dorman have decided to accept the offer for their own holdings and are recommending acceptance to the other shareholders. The formal offers are being sent out as soon as possible.

English Electric, in addition to their electrical engineering interests, are actively engaged in an intensive diesel engine and locomotive programme. Their Stafford works are alongside those of the Dorman company.

Dorman's high speed oil engines are produced for marine and industrial applications. They are also ferrous and non-ferrous founders. Early in 1959 Dormans bought W. G. BAGNALL, the locomotive manufacturers.

New Heavy Engineering Subsidiary in India

The widespread BOOKER GROUP, which has interests in the West Indies, British Guiana, Canada, Central Africa and the United Kingdom, is setting up a company in India with the Sawhney organization, of India. The new company, in which Bookers will hold a 50 per cent interest, is being named the TRIVENI ENGINEERING WORKS.

A heavy engineering works will be established, manufacturing sugar machinery under licence from GEORGE FLETCHER, of Derby, and DUNCAN STEWART, of Glasgow. Both these firms are members of the BOOKERS ENGINEERING HOLDINGS group. Industrial process turbines are also to be produced by Triveni, under licence from PETER BROTHERHOOD.

The Sawhney organization have a major stake in the Indian sugar industry. They are responsible for managing four large sugar factories in Uttar Pradesh and another large works in West Pakistan. The sugar machinery companies of the £20 million Booker group are acting as technical consultants in the establishment of the Triveni Engineering works and are to provide planning and manufacturing advice.

The new works will be near Allahabad, in the Triveni district of Uttar Pradesh, and will be centrally located for the whole of India. Mr. C. W. Tyrrell, a director of the Booker group and chairman of Booker Engineering Holdings, will serve with other Booker directors on the board, whose chief will be Mr. B. S. Sawhney.

Price Cuts In Uranium

Substantial reductions in the price of uranium have been announced by the United States Atomic Energy Commission. They take effect from 1 July.

Enriched uranium prices are to be cut by from 20 to 34 per cent and depleted uranium by between 41 and 64 per cent. The chairman of the USAEC, Mr. G. Seaborg, has said that for the users of the United States nuclear fuel, whether in US or overseas reactors, the cuts will lower the cost of nuclear power.

The Winget 3½ TS Concrete Mixer

Since the name Winget first became associated with concrete mixers, concrete has become a basic engineering material. Today a world without concrete is difficult to imagine.

THE Winget 3½ TS concrete mixer is taken for granted. It is the most popular example today of the small general purpose mixer; the firm favourite of every contractor from the jobbing builder to the large civil engineering contractor.

The basic arrangement of the Winget machine has remained unaltered for almost forty years. Every reader will have seen them churning away merrily like the one in Fig. 1. The humble concrete mixer does not hit the public eye; nor does it stir the imagination. The question is, upon what hidden qualities does the attraction of the little Winget machine depend?

The 3½ TS machine and its predecessors all have one factor in common, they possess twin professional qualifications. The more obvious one is ruggedness; the ability demanded of all contracting plant to keep on working under normal site conditions despite neglect and abuse.

The less obvious qualification, that of good mixing performance, is probably even more important. The strength of all concrete used in construction depends upon the successful cohesion of its ingredients. Improperly mixed concrete can make nonsense of the designer's calculations, and in an extreme case may even result in the erection of a dangerous structure. Although the tenant at the top of a block of skyscraper flats might occasionally wonder what would happen to him and his family if the building were to fall down, he is extremely unlikely to think of improperly mixed concrete as a possible cause.

The strength and reliability of concrete is unquestioned, like the use of the common-or-garden concrete mixer to prepare it. Being taken for granted is one of the greatest compliments that can be paid to a plant item of this kind. It also leads to speculation as to how its job was performed before it came along.

USE OF CONCRETE

The use of concrete in which sand and pebbles, or "aggregate," are united by cement to form a monolithic block or slab, was known long before the mechanical mixer. The Romans, for example used a form of concrete and had some ingenious mixing devices. Early in this century, however, mixing was still done by hand.

In the early days of the company now known as Winget Limited, of Rochester, Kent, application of mechanization to concrete production was not directed to mixing, but to moulding the concrete into blocks after mixing. In 1904 an American engineer, John McDowell of Columbus, Ohio, patented a radically original machine for this purpose. Its principle involved a "winging" action of the mould-box doors that both speeded output and made possible a

Fig. 1 A 3½ TS mixer on pneumatic tyres.

versatile range of moulded products. He called it the "Winget" concrete block machine, and formed a company to promote it.

In 1906 the Winget machine was noticed by a British engineer, John Faulder Burn, who at once saw its possibilities. A year later he purchased the British patent rights, and 1908 saw the formation of the UK Winget Concrete Machine Company, with its offices in West Hartlepool, but with no manufacturing capacity.

The Winget concrete block moulding machine quickly gained favour in the UK, and in many important public works the use of Winget blocks was specified. Burn was not content to let the business rest there, for as soon as the company had been formed he successfully negotiated the rights to manufacture and sell a circular pan concrete mixing machine, and it was followed in 1913 by a chain spade mixer.

In 1916 Faulder Burn established his own factory at Warwick. The real starting point in the history of the present-day Winget machines, however, came with the introduction in 1925 of the Burn-Lancaster drum with its semi-helix principle. Perhaps this feature more than any other has contributed to world-wide recognition of the high standard of performance set by Winget machines, and it was only recently superseded by the arrangement of internal lower blading shown in Figs. 2 and 5.

Needless to say, the surge of housebuilding between the wars led to a tremendous demand for concrete mixers and fierce competition between the manufacturers. Under these conditions the range of concrete mixers quickly became extremely diverse; the drive, for instance could be by electric motor, petrol engine, or even by hand. Each manufacturer was constantly striving to go one better, yet still keeping down his price. The year 1922 saw Winget introducing the first open drum mixers of 3 cu. ft mixed batch capacity; later the same machines were upgraded to 3½ cu. ft This size is now a standard specification and is generally referred to as the 5/3½ size—the 5 denoting the unmixed batch volume in cu. ft.

In 1930 the present management, under the chairmanship of Robert Ducas, took over, following Burn's early death. About the same time a significant change in policy affecting Winget's 5/3½ mixers took place. Hitherto, these machines were constantly having refinements added, often at customers' request, until they became quite complicated, as Fig. 3 shows. Additions included an elevating hopper, tilting water tank above the drum, and even a winch. Suddenly it was seen that continuing success of the 5/3½ did not lie in over-complication, and thenceforward it became the straightforward simple machine without "frills" that it is today.

Open drum mixers rely on a lifting action during mixing to ensure that the small aggregate, the densest constituent of the concrete, does not graduate to the bottom of the drum. Neither must the small aggregate be allowed to concentrate around the drum periphery due to the centrifugal effect. Both tendencies are resisted by the use of internal blading, the design of which depends on both the speed and direction of drum rotation. The Burn-Lancaster semi-helix drum base provided the required lifting action, in combination with a figure-of-eight mixing action to ensure that each particle of aggregate became completely coated with hydrated cement. Since the mixing performance of the semi-helix drum base was such an improvement on the plain drum, the patent rights were closely guarded.

Another important innovation in 1925 was the substitution of a welded tubular frame for the more conventional channel-and-angle arrangement. The tubular design offered a good strength factor, lightness for transport, good access for wheelbarrows, and above all, eliminated the flat surfaces that had hitherto so quickly become heaped with concrete. It also lent itself to repetitive assembly using jigs and fixtures.

Around 1930 therefore, after a period of flux, the Winget 5/3½ machine settled down to thirty years of success with only minor alterations periodically. Early improvements included the provision of a balanced handwheel instead of a lever for tilting, to control the discharge; the use of ball and roller bearings in place of plain bearings for the drum drive bevel pinion shaft; and alterations to the wheels. The petrol engine was adopted as standard, initially a 1-1½ hp

Fig. 2 Present-day arrangement of drum blading.

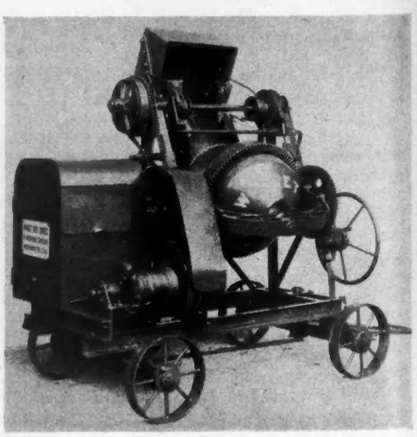


Fig. 3 Pre-1925 5/3½ concrete mixer, with winch.

Fig. 4 Success assured by a combination of original features and long working life.

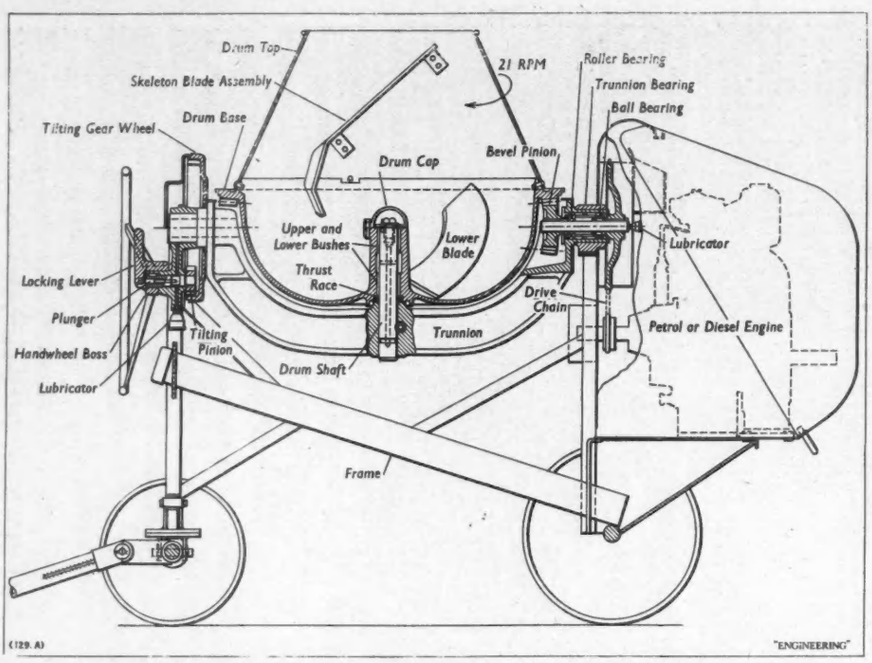


Fig. 5 Sectioned drawing of 3½ TS machine. The latest version has four 16 in dia pressed steel wheels.

engine of Petter or Lister manufacture. The tubular frame machine became known as the O5—a name which quickly became better known among contractors than the name Winget.

In 1934 Winget moved from Warwick to Rochester, Kent, where the premises of Aveling and Porter, the well known steam roller manufacturers, had become vacant. This move allowed further expansion of the company, but it did not affect the O5 which continued to sell in ever increasing numbers, both in Britain and abroad. For many years its price was kept constant at around £50; perhaps slightly dearer than comparable machines on the market, but always a best-seller.

The basis of the tubular frame was a pair of A-frames carrying the trunnion bearings, braced apart by a stout horizontal main tube beneath. The engine mounting is bracketted rigidly to one of the A-frames. Some years later wheelbarrow access was further improved by inclining the main tube. At one time the main tube contained the instruction sheet and toolkit, until they were transferred to a box within the lock-up engine housing.

WARTIME INTERRUPTION

After the wartime interruption the O5 was going strong again. In 1947 for reasons of safety the semi-helix drum base was changed to a hollow casting to eliminate the projecting contour on the outside of the drum. In 1955 it was realized that the same mixing performance could be attained by using a plain drum base casting with semi-helix blades bolted inside, an arrangement giving advantages in manufacture and servicing over the cast semi-helix.

Other postwar changes were to the wheels and also to the type of engine available. The 5/3½ mixer started to follow the trend towards using a diesel engine. The first diesel fitted machines appeared in 1947 and nowadays over 80 per cent of the machines are diesel driven. The coming of the diesel engine also, incidentally, meant changing the direction of drum rotation on all machines,

Another post-war development was the introduction of a two-wheeled fast trailer version on pneumatic tyres. Finally, in 1959 the 5/3½ mixers were given a more streamlined appearance.

Leading Particulars

Overall length	79 in (petrol), 84 in (diesel)
Overall width	39 in
Overall height	65 in
Road wheel diameter	16 in
Tilting wheel diameter	25 in
Drum mixed batch capacity	3½ cu. ft (plus 10 per cent overload)
Drum loading height	42 in
Drum discharge height	26 in

Engine Alternatives

hp	Speed (rpm)	Capacity (cc)
	Petrol	
1½	700 Lister	347
1½	750 Petter	467
1½	2,130 Villiers 12 RG	120
1¼	700 Wolseley	405
	Diesel	
1½	1,100 Petter	348
1¼	900 Lister AD	405

Abrasion-resisting Meehanite cast iron is used for the drum base. Cast teeth around the outer edge engage with the bevel driving pinion. The drum top and the internal skeleton and lower blading are of mild steel. The drum runs on a fixed internal shaft with two plain anti-friction bearing bushes, and a Skefco ball thrust race transmits the weight of the drum on to the trunnion. The trunnion itself is in Meehanite CI and is carried in plain bearings, the one at the engine end being hollow to accommodate the bevel pinion shaft bearings.

Drive is by means of roller chain and sprockets from the engine crankshaft to the bevel pinion shaft. This shaft runs in accurately mounted Skefco ball and roller bearings within the hollow trunnion end, and seals are provided to exclude grit and retain grease. All running parts are fed by only three Stauffer lubricators placed in protected, yet obvious, positions.

The drum-trunnion assembly is tilted by a large diameter spoked handwheel operating through an internal toothed gearwheel and machine cut pinion. A spring-loaded catch locks the handwheel when the drum reaches the correct mixing angle.

The table indicates the choices of engine available. The petrol engine is still fitted to 50 per cent of the export machines, which account for roughly 30 per cent of the total 3½TS production. The number absorbed by the home market each year remains fairly constant, despite the current trend towards central batch mixing stations and "ready mixed" concrete.

Unfortunately, the export of small concrete mixers from the UK is restricted by ever-increasing tariffs and licence controls imposed by many countries which were previously very good Winget customers. Nevertheless, the company remain responsible for the bulk of concrete-producing machinery exported.

The only valid criticism of the 3½TS compared with other makes might be that of weight. Though this implies lasting strength, the future may well see a somewhat lighter machine; and also one requiring even less maintenance (a trend in which Winget have always led) partly by using self-lubricating bearings.

Manufacturers of contractors' plant generally are having to face up to the fact that in many cases the equipment will receive very little maintenance, particularly in certain overseas territories. So the appeal of the simple trouble-free machine, common to all countries, is even more marked in the developing areas of Africa and Asia, which explains why the little Winget mixer is found in all latitudes and climates. Not only is it simple, but its operation is clearly evident to even the least skilled operator.

Abroad the Winget 5/3½ is often called upon to perform unusual feats of performance by normal British standards. India provides an example of a "fringe" benefit in that Winget packing cases make good coffins! The long life of a Winget drum means that a foreign contractor can make himself a new mixer by repeatedly using the drum off an old machine.

By describing a machine of such remarkable longevity, ENGINEERING do not wish to create the impression that Winget machines last for ever, though they do last a long time.

The famous 5/3½T concrete mixer is not all that Winget have to be proud of, and it is only one of an extensive range of concrete mixers. Diversification of products has also taken place to some extent, notably with refrigeration equipment and wire mill machinery.

Winget's research facilities are unrivalled in the concrete machinery industry, and in 1936 the company were the first to use wet analysis of concrete. Today they manufacture all kinds of concrete mixing machinery, including the latest and largest batch plants for some of the world's largest construction projects.

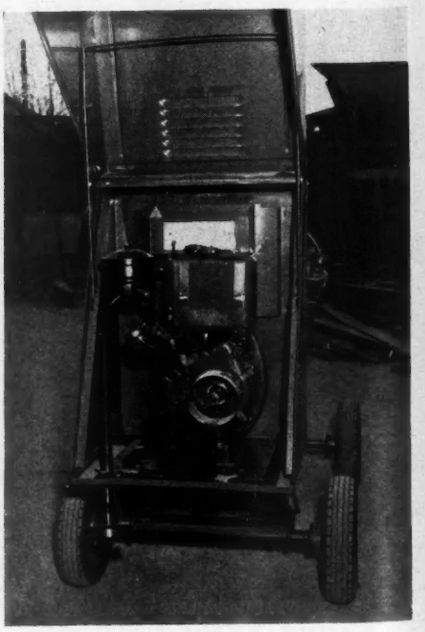


Fig. 6 Housing raised to give access to engine.

Automatic Yarn Monitor for Linen Industry

A new example of the value of cooperative research was seen recently by HRH the Duke of Edinburgh, when he was shown an electronic machine known as AMY (automatic monitor yarn) during a visit to Belfast.

This new machine, which should shortly become available commercially, has its origins in the Research Institute at Lambeg, the home of the Linen Industry Research Association. It was here that a device known as the "photoslubber", which is used for the photoelectric detection and elimination of gross faults or irregularities in yarns, had been designed. The use of the photoslubber led to the idea of having an electronic analysis made of the faults it detected.

As the electronic ideas developed, further discussions at LIRA took place and it became apparent that a new machine could be created which would do much more than analyse faults. It would be suitable for quality control in the spinning process for it would give an accurate determination of the yarn characteristics and allow comparative assessments of various yarns—advantages which would be of inestimable value to the spinners and weavers of the linen and other textile trades. Conventional inspection systems for this purpose had become outdated and the need for such a machine was now imperative because of other technological advances.

As work proceeded it became apparent that help was needed on the electronics side and it was at this point that the chief research engineer of Short Brothers and Harlands, Limited, was approached. Their precision engineering division readily cooperated and the result is the electronic machine which is now in use. Negotiations are now proceeding for AMY to be manufactured (under licence from Wm. Ewart & Son Limited) and marketed by Newmark Instruments Limited, one of the British firms who specialize in textile electronics.

The story of AMY has completed a full circle because, having started as an idea at LIRA, it then returned for help in the analysis of the results and the correlation of AMY counts with practical standards. In the carrying out of this work AMY was found to be extremely valuable as a research tool. It inspects yarn at the rate of 1,800 ft per minute and provides information on the characteristics of yarn in a much more detailed form than even the best traditional methods and alternative modern instruments. The use of AMY in research provides full information on fibre disturbances rapidly and accurately, and eliminates the need for much laborious and time-consuming work in the making of measurements and in the analysis of their results.

AMY measures the disturbances in yarn thickness, arranges them into three groups of different thicknesses and five groups of different lengths, and records the total number in each group, the various totals being shown on separate counter dials. The disturbances usually measured are portions of the yarn which are thicker than normal, but if desired AMY is easily adapted to measure portions which are thinner than normal. The overall long term variation is monitored by a sensitive relay system which detects long lengths of excessively thick or thin yarn.

In addition to its obvious value in research, quality control, and fault detection, the detailed analysis provided by AMY will assist in maintaining spinning machinery at peak efficiency. Greater lengths of yarn than ever before can be inspected economically and the increased amount of easily interpreted data provided will lead to many new approaches in textile processing.

Large Water Tunnel for Propeller Research

A new water tunnel at the Ship Hydrodynamics Laboratory, Teddington, which has been designed for research work on propellers up to 24 in diameter and the testing of hydrofoils, etc., is said to be one of the largest of its type in the world. It has a circuit of more than 500 ft, and a water velocity through the closed test section of up to 50 ft per second. Water pressures from 0 to 6 atmospheres can be accurately maintained.

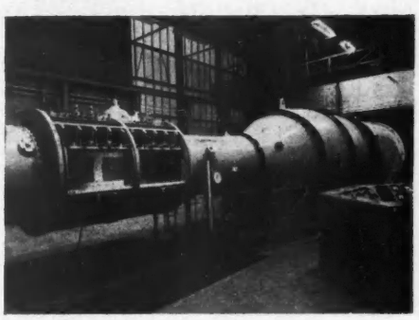
The full circuit comprises two large parallel tubes which extend vertically for about 180 ft below ground, 87 ft apart and connected at the top and bottom by similar tubes in a horizontal plane. The testing length, which is contained in a restricted portion of the upper horizontal tube, is only some seven feet long and 44 in in diameter.

The remainder of the circuit, with a diameter of about 10 ft, is necessary to achieve re-absorption of air bubbles which may be created by turbulence along the test length. In cavitation studies, the air bubbles produced are extremely difficult to bring back into solution in the water, but must be re-absorbed before the water is recirculated through the test section. This is achieved in the new tunnel by taking the circuit some 180 ft below ground, thereby increasing the pressure on the air and encouraging it to re-dissolve. The larger diameter of the non-test parts of the tunnel permits the water to flow more slowly, reducing wall friction and turbulence and correspondingly allowing more time for the separated air to dissolve.

The water in the tunnel is circulated by one 92 in axial impeller, with a variable speed drive from electric motors of 1,052 hp maximum continuous rating. Blade pitch can be adjusted between runs to obtain optimum pumping characteristics over a range of conditions. The impeller is located about 35 ft from the top of the down limb of the circuit, where the water heat is sufficient to prevent cavitation.

A long downstream shaft, driven by a 300 hp motor, is run inside the tunnel to the test section, which is accessible through removable doors after the water in the top horizontal limb has been drained into below-ground storage tanks.

To pressure the circuit and to maintain pressure during tests, a Megator type GH4 pump set is used. This pump operates on continuous recirculation through a small subsidiary tank, with a by-pass valve incorporated in the system to permit a proportion of the flow to be introduced and withdrawn from the tunnel circuit. The by-pass valve is continuously regulated by a servo system connected with monitoring instruments in the test section. This system of control enables the pressure inside the tunnel to be maintained within fine limits.



The 500 ft circuit of the Ship Hydrodynamics Laboratory's water tunnel is pressurised by a Megator GH4 pump set.

The below-ground limbs of the tunnel are of steel tube, set inside reinforced concrete rings, and lined on the inside with a corrosion resistant coating which reduces wall friction. For the upper limb, which contains the test section, the concrete rings are omitted.

Higher Temperature for Thermoelectricity

A new group of ceramic-type thermoelectric materials, which permit the direct conversion of heat into electricity at temperatures considerably above the melting point of copper, has been developed by the Westinghouse Electric Corporation, New York, USA.

The new materials are compounds of samarium and cerium—two metals belonging to a family of elements known as "rare earths." In the new materials the metals are chemically combined with sulphur to form differing varieties of two compounds—samarium sulphide and cerium sulphide.

In particular, these new materials show promise due to their excellent high-temperature stability and their thermoelectric efficiencies at temperatures as high as 2,000° F.

Work on these materials began when studies being carried out at Westinghouse indicated that certain of the rare earth materials might have desirable thermoelectric properties. Up to this point, research on rare earths had included little work on the preparation and properties of their sulphides.

Two families of rare earth sulphides can be prepared in a similar manner—by directly combining the pure metal with sulphur. In the case of samarium sulphide, the samarium and sulphur are heated to high temperatures in a protective atmosphere. The rate of temperature rise, final temperature attained, and length of reaction time must be very carefully controlled.

Following the chemical reaction between the samarium and the sulphur, the resulting sulphide is then crushed, compacted into small pellets, and sintered in a vacuum induction furnace. The composition of the various sulphides which result from the metal-sulphur reaction are determined by X-ray diffraction analysis. Physical, electrical and chemical tests are then made on the completed thermoelectric pellets.

There are many types of thermoelectric material available at present, each with its own optimum temperature. Normal practice when constructing a thermoelectric machines, therefore, is to use several thermoelectric junctions, each working at its favoured temperature and passing its waste heat down to the next one. In this way it is possible to construct a fairly efficient machine up to moderately high temperatures.

The advantage with the materials, therefore, is that the upper temperature can now be raised. This not only increases the range of heat sources that can be used to obtain electricity directly from heat, but it also provides an overall increase in thermal efficiency, since a heat engine is always more efficient at higher temperatures.

A New Technique for Colour Television

The main reason for the long delay in the arrival of colour television is that a cheap receiver technique has yet to be found. Of the several devices that have been proposed, the latest is called the "banana tube" system.

THE first practical colour television system to enjoy any measure of commercial success so far has been the American shadowmask tube. However, only a limited number of these have been sold in the United States in spite of the fact that colour television transmissions have been broadcast there for some years.

The main difference between a shadowmask and an ordinary black and white tube is that the former has three electron beams, each of which is made to strike its respective primary colour (red, green or blue) on the screen by means of a shadow mask. The fact that there are three cathodes and a complex screen makes this type of tube considerably more expensive than its monochrome counterpart. In addition to the increased expense, the shadowmask system has not gained a particularly good reputation for quality and realiability. However, at this point, it is only fair to say that a properly adjusted colour television receiver using a shadow mask tube can give a good picture, provided that the ambient light conditions are fairly favourable.

Economic considerations, therefore, appear to be by far the biggest drawback to the widespread use of the shadowmask technique. For this reason, considerable research and development effort has been spent on trying to develop a cheaper and, if possible, higher quality technique.

There are two ways in which the consumer-cost of colour television needs to be cut. The first is the initial cost of the receiver, and this is almost entirely dependent upon the complexity of the tube. The second is the replacement cost of the tube, which is undoubtedly the most expensive single item in the receiver. In both respects, particularly the latter, the newly developed banana tube system may score high marks.

"Banana Tube"

The banana tube, unlike its predecessors, is partly electronic and partly mechanical. The system consists of a relatively simple and inexpensive cathode ray tube, and a mechanical rotating lens system. The anticipated initial cost of the system is low compared with the shadowmask tube (see Table I), and the replacement due to failure of any of the component parts of the tube system is lower still.

The banana tube also has other advantages. It is far less sensitive to ambient light than the shadowmask system, in fact it gives quite adequate brightness and colour quality in full sunlight conditions. This is due to the fact that external light does not fall directly on to the tube's colour phosphors.

TABLE I:—*Comparative Costs*

Type of receiver	Comparative costs (arbitrary units)
21 in monochrome table model, using current techniques	100
Banana consolette, using immediately available techniques	280
Banana consolette, using techniques visualized as possible optimum	240
Shadowmask consolette, using current techniques	320

TABLE II:—*Comparison of Tube Contrast Ratios*

Ambient light	Banana tube	Shadowmask tube
Nil	40 : 1	25 : 1
4 ft-L (100W lamp 6 ft from display)	32 : 1	7 : 1
16 ft-L (100W lamp 3 ft from display)	19 : 1	4 : 1

With the current trend for "slim line" receivers, the banana tube can be considered as having a third advantage in that the receiver depth is only about a third of that of a typical shadowmask receiver.

These advantages are to some extent offset by one particularly important disadvantage—the field of vision is restricted in both the horizontal and vertical planes. However, these restrictions are not severe and, at the moment, efforts are being made to increase the vertical field angle so that, for all normal purposes, there will be no restriction to viewing.

In its present stage of development the receiver is also sensitive to changes in the external magnetic field surrounding it. This means that the receiver cannot be moved without resetting some of its controls. However, this may not be a disadvantage in the future, since it is confidently anticipated that this problem will soon be overcome by the design of a simple electrostatic system which will fit into the cathode ray tube itself.

Cheaper to Make

The banana television tube is simpler in appearance than an ordinary monochromatic tube; it may, therefore, be cheaper to manufacture. Its name is not highly indicative of its shape, in fact it was really given the name "banana" because of the existence of a rival tube design which has been given the name of "apple."

It consists of a glass cylinder with three phosphor stripes running along the length of the cylinder wall (actually there is also a fourth stripe which gives white light for ordinary monochromatic reproduction). The electron gun is at one end, and the high voltage terminal at the other. The beam from the gun is made to run along the phosphor stripes, being deflected downward, as shown in Fig. 2, by a permanent magnet placed around the tube. As the beam travels down the tube it is electronically moved from side to side so that, at any given instant, it strikes whichever phosphor colour the picture signal demands.

The net result of this is that the tube produces the rapid scanning that is required to obtain the lines of the final picture, leaving only the field scanning to be carried out by other means.

Mechanical Field Scanning

Having achieved the line make-up, the virtual image of successive lines is then made to run down the screen (in this case a hyperbolic mirror) by means of a system of three axially mounted rotating mirrors. Fig. 3 shows how this process is carried out.

A drum containing three tubular glass rods, spaced 120° apart, is simply placed over the tube (so that the drum and tube have a common axis), and then made to rotate. The result of this is that the lines of light generated by the colour tube pass through the three lenses, in succession, and appear on the screen as a stationary picture composed of 405 lines. In other words, the high speed line scanning is carried out electronically within the tube, and the low-speed field scanning is carried out mechanically by a rotating drum with three glass rods set into it.

Although there is a considerable tendency nowadays to replace mechanical devices with electrical ones wherever possible, there are occasions when the reverse is worthy of consideration. This appears to be such a case. The result of this form of exercise in the development of the banana tube has been that, compared with the shadowmask, both manufacturing costs and maintenance costs can conceivably be substantially reduced. Furthermore, since the mechanical parts are comparatively simple, there is a possibility that breakdown will be relatively infrequent, although there has been no lift-test evidence as yet to support this. There is also the important fact that ambient light does not affect the picture to any noticeable extent (see Table II).

Engineering Problems

At first sight, it appears to be a retrograde step to revert to mechanical devices in a tele-

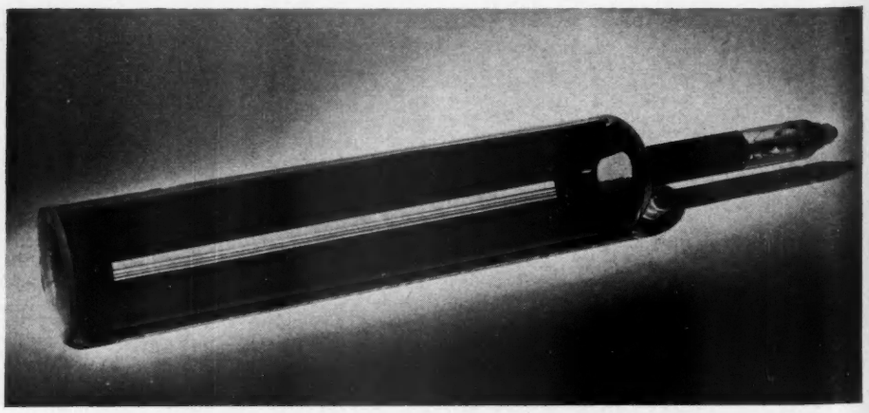


Fig. 1 Unlike a normal black and white cathode ray tube, the new tube has its phosphors running axially along its length. Three phosphors give the primary colours and a fourth produces normal, white light.

Research Report

on work of the

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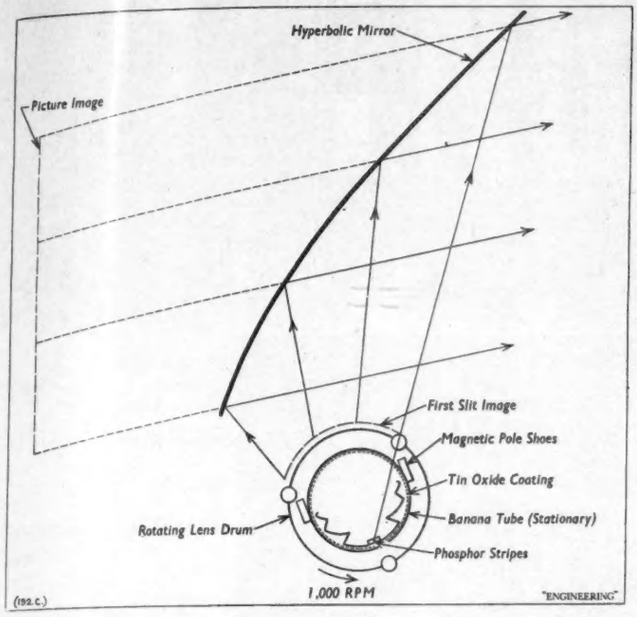
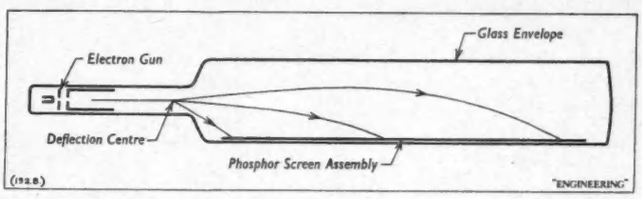


Fig. 2 (Below) The electron beam is given a high incidence angle on the phosphors by a permanent magnetic field.

Fig. 3 (Left) The lines of the picture are formed electronically within the tube. These are then made into a complete frame by a system of three rotating lenses and a hyperbolic mirror.



vision receiver; mechanical wear, noise, bulk, etc., look like being troublesome. However, through considerable development effort and ingenuity, this has not turned out to be the case.

The first problem that had to be solved in attempting to design a rotating lens system was to produce a drive mechanism which would: (*a*) rotate *exactly* at a predetermined speed (1,000 rpm); (*b*) be noise free; and (*c*) run without maintenance for at least 10,000 hours under the most strenuous conditions likely to be encountered.

A straightforward, squirrel cage induction motor, with a magnetic brake to control its speed, has been adopted for a drive mechanism. The motor, which has four poles and a pole speed of 1,500 rpm, is designed to run at one third slip.

To obtain the necessary brake torque, two techniques have been tried. The first was an eddy current disc brake and the second an integral brake incorporated within the motor housing and consisting of a dc winding on the motor stator. However, although the latter technique was an improvement on the first, neither gave entire satisfaction. For this reason, a third method has been designed and will be tried in later models. This consists of a separately mounted brake with a radial air gap between magnetic poles, used in conjunction with an eddy current ring. By using a ring instead of the more usual disc, the drive and lens drum assembly will have some freedom of movement in the axial direction. Such a system is expected to be capable of giving the correct drive speed within acceptable limits. The motor drives the lens drum through an axial coupling at one end; at the other end the drum is supported by a system of bearing wheels.

Many types of bearing system were investigated before it was finally decided to use a system of four free-running plastic rollers. By exhaustive tests on various materials a suitable ptfe compound was arrived at; giving the required 10,000 hours of trouble-free life with very little noise.

Since solid glass or acrylic rods with the required dimensional tolerances and with scratch-proof surfaces are very difficult to obtain cheaply, the final design for the lenses has been based on glass tubing (which has acceptable dimensional tolerances) with a liquid filling. In fact, water has been found to be quite satisfactory for the filling material, provided that an expansion device is fitted and sealed into one of the tube's ends.

The positions of the glass rods in the carrier drum are critical. However, no serious difficulty has been experienced in cementing the lenses into position with the aid of suitable jigs, and it is not expected that this would give rise to mass production manufacturing problems.

To obtain an adequate field of view for normal domestic requirements, the curved viewing mirror is made larger than the picture image. During development, a hyperbolic mirror of 28 in width has been used. This gives a horizontal viewing angle of about 50° for a picture with a 20 in diagonal. Movement of the viewer results in movement of the image relative to the mirror. This means that uneveness in the mirror surface would produce image distortions with viewer movements.

Both metal and glass mirrors have been tried out experimentally and the latter has been found to be the most satisfactory. The reflecting surface is deposited on the front of the glass, to prevent optical "double image" effects. By coating the reflector surface with a suitable hard lacquer the mirror has been found to stand up to lengthy periods of use with no noticeable wear.

Future Prospects

Although a number of highly successful demonstrations of the banana display system have been given there is no doubt that much experimental work is still to be done. It is still a matter of speculation whether or not the banana tube or the apple tube (or some other device) will succeed the more established shadowmask technique for widespread domestic use. This situation cannot be resolved until a later stage of development is reached, when the technical and economic pros and cons will be more apparent.

In a paper recently presented to the Institution of Electrical Engineers the pioneer of the banana tube, Dr. Schagen, concluded by saying, "When considering the possible future of the device the fact has to be borne in mind that an unconventional alternative to an already established technique must offer some clear advantages. In the case of the banana tube the possible advantages to aim at are a lower receiver cost, lower cost of tube replacement, and ease of setting up and maintaining a good colour picture. It must also be taken into account that the shadowmask tube in its present form is a result of a major research and engineering effort over a considerable period of time, whereas the banana tube display device is still in an early stage of development and therefore more likely to be subject to further significant improvements.

"The most unconventional features of the display device are the picture presentation in the form of a virtual image suspended in space behind the viewing mirror, and the introduction of mechanically moving components in the system. It is difficult to predict the psychological reaction of the viewing public to this type of picture presentation. The limited number of observers who have seen the pictures certainly did not object to the virtual image, while the flatness of the picture plane and the absence of corner cutting were considered to be a clear advantage."

Fig. 4 An experimental receiver, using the new tube, was recently used to give a colour television demonstration at a meeting of the Institution of Electrical Engineers.

Cleaning the Air

IN WINTER time in this country the housewife is faced with a constant compromise, how to keep the air in the house fresh without introducing too much cold air from outside. In other countries the problem may be reversed—how to keep the air fresh and cool without introducing too much hot air from outside. This all leads to air conditioning.

Domestic air conditioning in Britain is still regarded rather doubtfully as being a bit "fancy," but there is a market and it is growing. Full air conditioning, where the incoming air is treated for dust and moisture and either heated or cooled according to external conditions, is rarely needed here, but a modified form embracing filtering and warming is certainly making some headway.

The kitchen presents a problem of its own in that the smells from cooking have to be dealt with as well as keeping the room warm (or cool). Several makes of extractor fan for fitting in the window are on the market as well as more elaborate installations that draw the fumes from the cooker out through a vent in the wall. An arrangement that needs no connection with the exterior is the ductless hood shown in the first illustration.

The hood is made by Gold Star Domestic Appliances Limited, of 65 Victoria Street,

London SW1, and is designed to mount directly on the wall over the cooker. It can be incorporated in an arrangement of wall cupboards if one exists, or it can stand freely on its own.

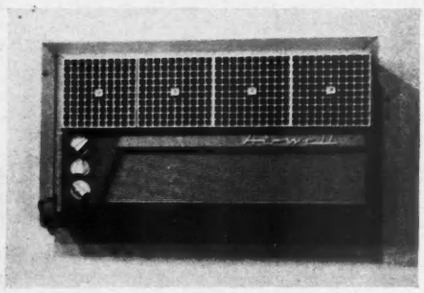
Within the hood is a fan driven by an electric motor which draws in air from the room through two filters. The first is intended to remove grease particles and can itself be removed easily for regular cleaning, and the second is composed of activated charcoal which adsorbs gaseous odours and fine smoke particles. This second filter has a long life but can be replaced quite simply when exhausted. The impeller fan will give a complete change of air in a small kitchen every 15 minutes.

In the front of the hood is a 60 watt tubular light to illuminate the cooker hob. It is controlled by the same switch as the fan motor. In addition there is a pilot light that indicates the hood is ready for use. Two widths of hood are made, 24 in and 36 in; both are 19 in deep and 6⅜ in high. They are arranged to operate from standard 220-240V mains, and installation consists simply of screwing them to the wall and connecting up to a supply point.

From France comes the air conditioning unit in the second illustration. It is made by Airwell, 24 Boulevard de la République, Chatou, Seine-et-Oise. It is planned for complete air conditioning—humidifying, cooling, ventilating, filtering, supplying fresh air, evacuating stale air, and if desired for complementary heating. Control is by multi-position selector switches. The ambient temperature is automatically set and the air moisture content is maintained within optimum comfort values. Units are available in sizes from ½ hp to 2 hp.

A very recent addition to the British range is the Guardaire shown in the third illustration and made by Winston Electronics Limited, Shepperton, Middlesex. It is designed to enliven the air in any room or office, as well as filtering it. The operation is based on the belief, for which there is medical evidence, that the presence of negatively charged ions in the air have an invigorating effect, removing the feeling of stuffiness.

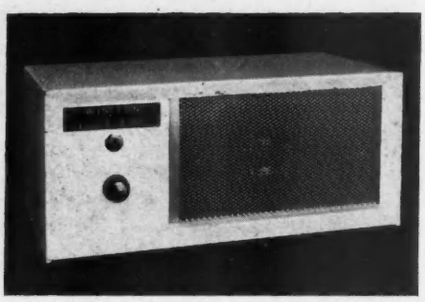
The sequence of operations in the Guardaire is that air is drawn in from the room through a filter that removes all fine particles including tobacco smoke, over activated carbon to remove odours, then past ultra-violet lamps to produce negative ions at 3,000 per cc, and finally through



(*Above*) *Full air conditioning is possible with the Airwell unit.*

(*Left*) *The Gold Star ductless hood eliminates kitchen smells and dust without needing any external outlet.*

(*Below*) *Negative ions are produced by the Guardaire to remove stuffiness from the room.*



an ion multiplier giving an output of 100,000 ions per cc to be dispersed through the room. This rate of production counteracts the rate of destruction of negative ions, and the irradiation also kills a number of viruses and bacteria, so assisting in the prevention of the spread of coughs, colds and community complaints. The filtering out of pollen plus the negative ions is claimed to give relief to many sufferers from hay fever. It is said that "the inhalation of negatively ionized air causes a feeling of well-being, exhilaration, good temper, euphoria, tranquillization, and optimism" while positively ionized air as found in stuffy atmospheres "causes dizziness, headaches, light fatigue, laboured and more frequent breathing, dryness and itching of the nose, difficulty in swallowing, ill temper, depression and even fear."

The Guardaire measures 14 in by 6 in by 7¾ in and is rated for standard mains supplies, using one unit in 12 hours. One equipment is sufficient for dealing with spaces of about 4,000 cu. ft, equivalent to a room 20 ft by 20 ft by 10 ft high. It weighs less than 5 lb.

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